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MBA PROFESSIONAL REPORT

**A Breakdown, Application, and Evaluation
of the Resiliency Analysis Support Tool (RAST)
From the Operator's Perspective**

**By: James Lomax,
Ji Ahn, and
Lester Shewmake
June 2013**

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OPERATOR'S PERSPECTIVE**

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ABSTRACT

This project investigates the current Resiliency Analysis Support Tool (RAST) and its usability with Department of Defense (DoD) military and civilian personnel. With the unexpected possibilities of natural and man-made disasters worldwide, RAST could inform combatant commanders (CCDRs) and component commanders of resources to facilitate recovery and provide humanitarian assistance/disaster relief (HA/DR). However, due to the lack of knowledge of RAST, the potential benefits of implementation of this system remain unnoticed. This project provides an assessment of the current RAST system, its ease of understanding with potential users, and an application of the system to a particular disaster in the Pacific Command (PACOM) area of responsibility (AOR).

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LIST OF ACRONYMS AND ABBREVIATIONS

AOR	Area of Responsibility
ASW	Anti-Submarine Warfare
AW	Air Warfare
CATS	Consequences Assessment Tool Set
CCDR	Combatant Commander
COCOM	Combatant Command
COE-DMHA	Center of Excellence in Disaster Management and Humanitarian Assistance
DoD	Department of Defense
DSCA	Defense Support of Civil Authorities
DTRA	Defense Threat Reduction Agency
EOC	Emergency Operations Center
FDR	Foreign Disaster Relief
FEMA	Federal Emergency Management Agency
FHA	Foreign Humanitarian Assistance
GIS	Geographic Information System
HA/DR	Humanitarian Assistance/Disaster Relief
HAST	Humanitarian Assistance Survey Team
IGO	Intergovernmental Organizations
JFC	Joint Task Force Commander
JTF	Joint Task Force
JWID	Joint Warrior Interoperability Demonstration
MIO	Maritime Interdiction Operations
NHC	National Hurricane Center
NSC	National Security Council
NATO	North Atlantic Treaty Organization
NGO	Non-Governmental Organization
ONR	Office of Naval Research

PACOM	Pacific Command
PCC	Policy Coordination Committee
RAST	Resiliency Analysis Support Tool
RSDREA	Robert T. Stafford Disaster Relief and Emergency Assistance Act
SAIC	Science Application International Corporation
SOUTHCOM	Southern Command
SW	Strike Warfare
TRACS	The Resiliency Assessment and Coordination System
USAID	U.S. Agency for International Development
UN	United Nations

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I. INTRODUCTION

A. BACKGROUND

The United States military is composed of multiple operational missions that are met with precision and information-based decisions to ensure mission completeness. These missions range from air warfare (AW), maritime interdiction operations (MIO), strike warfare (SW), and anti-submarine warfare (ASW), just to name a few. One of the major missions that has increasing combatant command (COCOM) involvement is the ability to provide humanitarian assistance and disaster relief (HA/DR). HA/DR can involve not only multiple branches in the U.S. military but also multiple nations to bring relief to countries that have sustained a natural or man-made disaster. With the advancements in modern technology and the United States military forces' focus on relief efforts during major disasters, tools that provide assistance and inform military personnel of the availability of local resources are a tremendous advantage.

Having access to these resources helps organizations and agencies conducting HA/DR operations to reduce human suffering and casualties; with decision support tools, both military and civilian leaders can make informed decisions during crisis response and better prepare for impending crises. To better implement an effective response, improvement in the logistic provision of supplies and strategic implementation of military resources is needed. Figure 1 depicts the number of natural disasters reported from 1975–2011. The increase shown in Figure 1 is not representative of an actual increase in natural disasters but of an increase in media reporting and advancements in the communication of those disasters. Figure 1 depicts that because of the large number of disasters that occur every year and the unpredictability of those disasters, organizations and agencies need to have readily available information about supplies and how best to distribute those supplies.

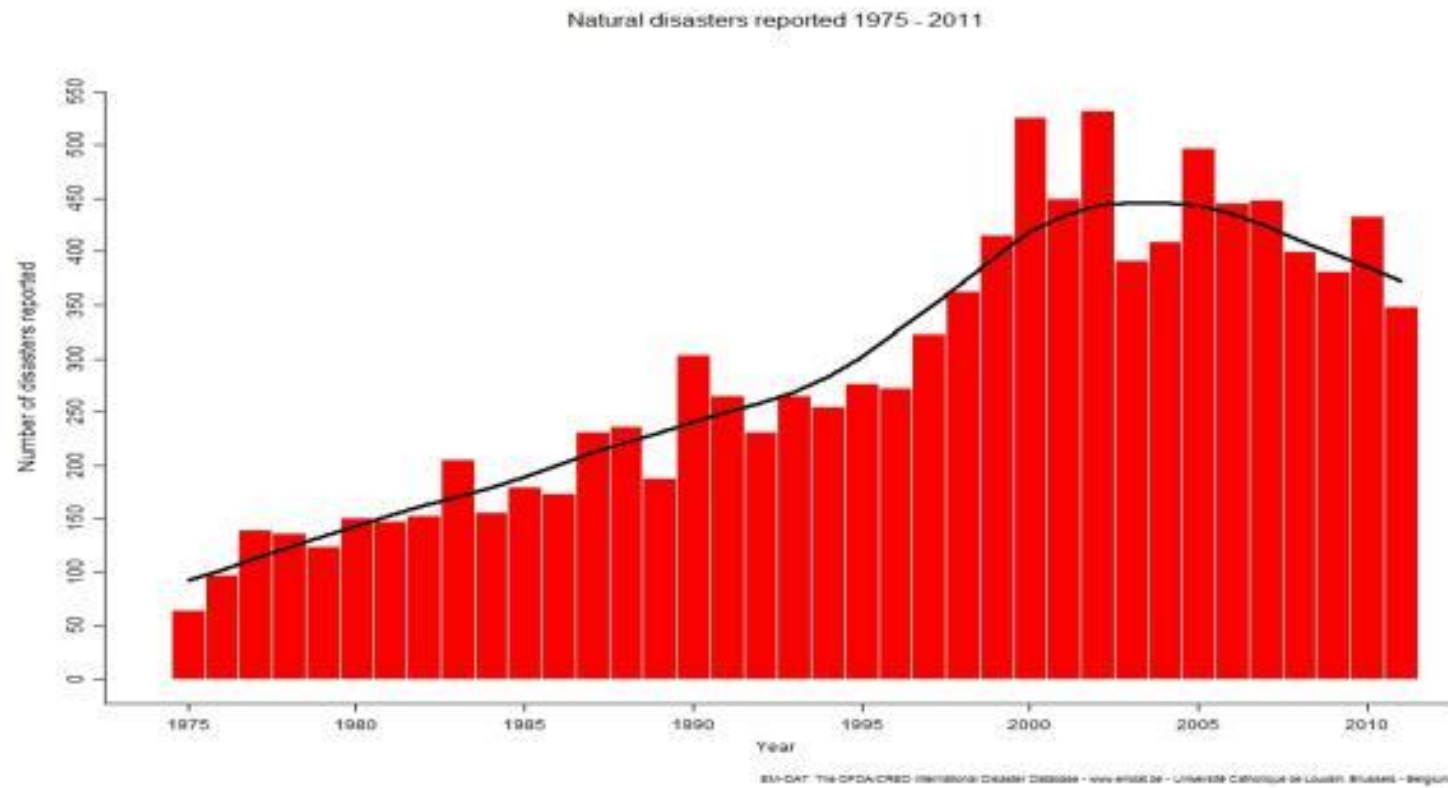


Figure 1. Number of Natural Disasters Reported From 1975–2011 (From EM-DAT, 2012)

In the case of the United States' military, it is key for all combatant commanders (CCDRs) to have readily available critical HA/DR data that reside in their respective geographic domains so that fully informed decisions are made. Disaster response requires real-time access to common community information; this information must be readily available for CCDRs to effectively decide how to best allocate U.S. military forces and resources. Advancements in technology have created tools for identifying resources available in multiple countries and intuitively displaying and sharing actionable HA/DR information for not only U.S. forces and CCDRs, but also neighboring countries that wish to assist by providing resources.

The Resiliency Analysis Support Tool, known as RAST, is one such advancement in technology that can have the potential to help serve as a decision support tool for military and civilian personnel to effectively implement and display resources readily available by the country in need. RAST is a concept design prototype developed by Oakridge National Laboratory. Their design is for a configurable web-based analytic system that contains a baseline and operational assessment framework for military forces and civilian-based organizations to make informed decisions about the use of readily available resources. Since RAST is a concept design prototype, all references should be about what RAST "could be." However, for purposes of easier reading, we have chosen to refer to RAST in present tense throughout this report. RAST diagnoses community needs by sector, system, and population functionality and serves to link response to recovery. It is capable of doing this by interfacing with civilian, non-governmental organization (NGO), international humanitarian, and other military systems, and by filtering and organizing real-time data by temporal and spatial characteristics, and relevance to community sectors.

The RAST concept provides a visual display of community resources and allows a common understanding of complex humanitarian situations and crises to support decision-making by military and civilian personnel. It could also serve as a situational awareness tool of available resources and supplies prior to military or civilian forces' arrival. Military and civilian forces' could better understand and assess the needs of the people in distress and even prepare by building a safety stock of supplies in strategic

locations in the event of a disaster. We analyze RAST in thorough detail to show its capabilities by breaking down its many system components and evaluating its data repository and its social and community frameworks. Figure 2 shows a snapshot of RAST, which is examined in intricate detail in Chapter 4 and Chapter 5.

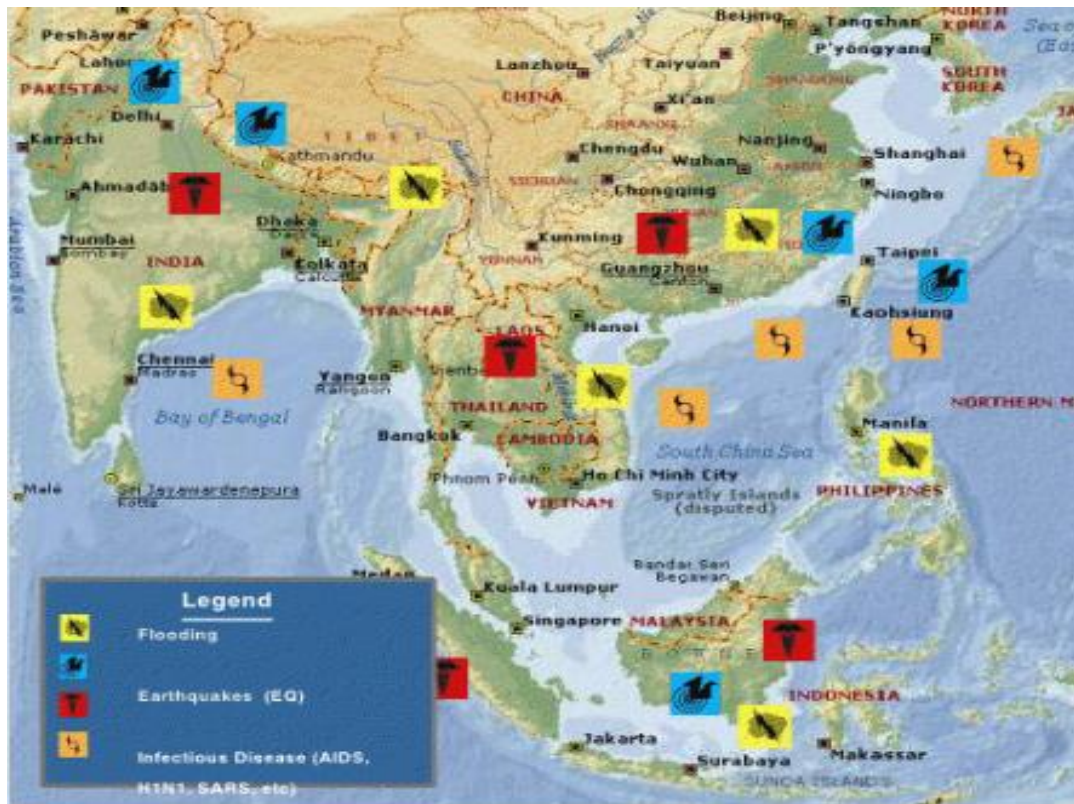


Figure 2. Snapshot of RAST in the Pacific Fleet Area of Responsibility (From Center for Excellence in Disaster Management and Humanitarian Assistance [COE-DMHA], 2011)

When relevant logistics data specific to a CCDR's area of responsibility (AOR) is available, the adverse impact on human life is reduced tremendously. When RAST is made available to the CCDRs (or to private-sector organizations), coordination of relief efforts and logistics operations can be implemented in a timely manner, providing stabilization of the area and relief and lifesaving services to those in need. This concept will help to increase preparedness for military and civilian organizations while serving as a communications tool that can be updated with ease.

B. PURPOSE AND RESEARCH OBJECTIVE

The purpose of this research project is to explore the background and application of RAST in supporting military and civilian organizations in HA/DR. Specific areas of analysis include a thorough breakdown of the software and the capabilities and benefits it offers organizational leaders so that better informed decisions are made and resource allocation of supplies is conducted more efficiently.

With the RAST computer software, input of community resource data can be collected from any electronic data source or sensor or by a government provision requiring this information. This data input will help feed into a larger network display system that will establish a common understanding for action and collaboration. With the knowledge of available resources pre- and post-crisis, organizations (specific to this research, CCDRs) will be able to effectively utilize the military resources that are available to provide a timely and efficient response.

The research objective was to acquire available background data on RAST to describe its benefits to civilian and military organizations. Also, in this report we provide military users with a basic understanding of the system components to include a step-by-step framework of the program while running a scenario-based application in the Pacific Command (PACOM) AOR.

C. ORGANIZATION OF REPORT

We have structured this report into five chapters. In the first chapter, we introduced the project. In the second chapter, we review the literature and analyze the past effectiveness of HA/DR in using technology and the current use of technology in the preparation and execution of disaster relief in natural and man-made disasters. In the third chapter, we show the methodology used for collecting data and analyzing RAST. In the fourth chapter, we provide information pertaining to increasing awareness of disasters, the DoD's strategy in HA/DR, and the potential "customers" of RAST. In the fifth chapter, we observe the data collected and analyze RAST, with emphasis on the framework of the software and remarks on the usefulness while running a PACOM-based disaster relief scenario. In the sixth chapter, we provide recommendations to better improve RAST as it is continued to be developed. In the seventh chapter, we present the conclusion and recommendations for follow-on research.

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II. LITERATURE REVIEW

A. HUMANITARIAN ASSISTANCE AND DISASTER RELIEF

1. HA/DR Life Cycle

In their research, Kovacs and Spens (2007) clearly displayed the three phases of disaster relief operations in terms of preparation, immediate response, and reconstruction, as shown in Figure 3. Kovacs and Spens (2007) defined the preparation phase as the period before a disaster strikes, the immediate response phase as the time period immediately after a disaster strikes, and the reconstruction phase as the aftermath of a natural disaster.

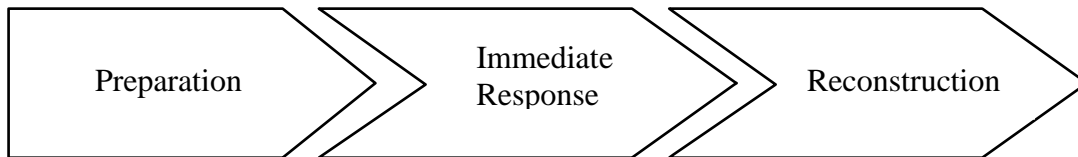


Figure 3. Phases of Disaster Relief Operations (From Kovacs & Spens, 2007)

Apte (2009) took a similar approach in further developing the time line of the humanitarian supply chain. As depicted in Figure 4, Apte (2009) provided the process flow model of humanitarian logistics that is divided into three different stages along the time line: preparedness, response, and recovery. Preparation in anticipation of a disaster involves the prepositioning of assets and the preparation of infrastructure. Immediately after a disaster strikes, a relief response that involves ramp-up and sustainment follows. Last, the recovery effort is a long-term, ongoing process that includes collecting data about lessons learned. Although disasters are practically impossible to predict, Apte and Yoder (2011) explained that an adequate preparation for earthquakes in fault zones, volcanic activity in cities near volcanoes, or hurricanes in hurricane-prone regions can be made due to the probability of a disaster occurring.

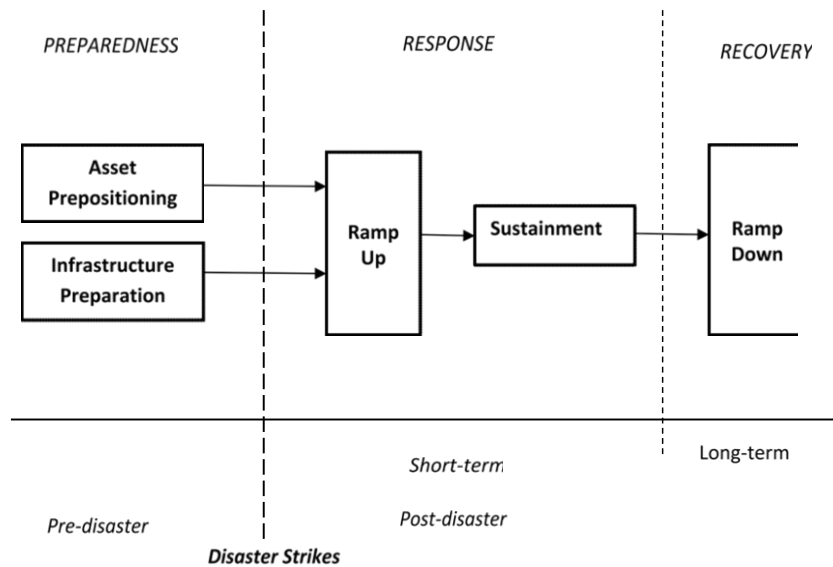


Figure 4. Time Line of the Humanitarian Supply Chain (From Apte, 2009)

2. Challenges in HA/DR

Lessons learned from previous catastrophes have led to significant observations and analysis among humanitarian logisticians (Apte, 2009). U.S. military lessons learned from the Indian Ocean tsunami, Hurricane Katrina, and the Haitian earthquake revealed that there is a tendency to relearn lessons from the past. Among the greatest lessons learned from past HA/DR operations are challenges in transmitting communication, information exchange, and interagency coordination (Koch, 2011). Lack of planning and coordination results in information gaps and the unclear assignment of member responsibilities, which, therefore, unfavorably affect the critical support provided (Apte & Yoder, 2011). To mitigate the negative outcomes during future HA/DR efforts, it is important for CCDRs to apply what was learned from past HA/DR operations and implement improved plans to correct inefficiencies (Koch, 2011).

In order for commanders to make decisions for resource allocation, effective communications and interagency cooperation are vital to the overall success of HA/DR operations:

For example, the military brought communications, logistics and planning capabilities that were critical to Katrina relief operations. Host governments are important actors as they control assets such as

warehouses or fuel depots. Host country logistics or regional service providers are another important set of actors that can either facilitate or constrain the operational effectiveness of humanitarian logistics operations. Extra-regional logistics service providers are also important in the supply process, e.g., DHL has contributed to the international relief efforts to deliver aid supplies to people and communities affected by the South Asia earthquake. (Kovacs & Spens, 2007, p. 107)

Since HA/DR operations require contributions from everyone involved, failure to integrate the agencies and understand the interagency process can damage the overall effort of an HA/DR operation (Koch, 2011). Strengthening the transmission of communications, information exchange, and interagency coordination can eliminate duplicate efforts and improve efficiency and effectiveness (Apte & Yoder, 2011). Figure 5 illustrates the connection of different players in the supply network of humanitarian aid (Kovacs & Spens, 2007).

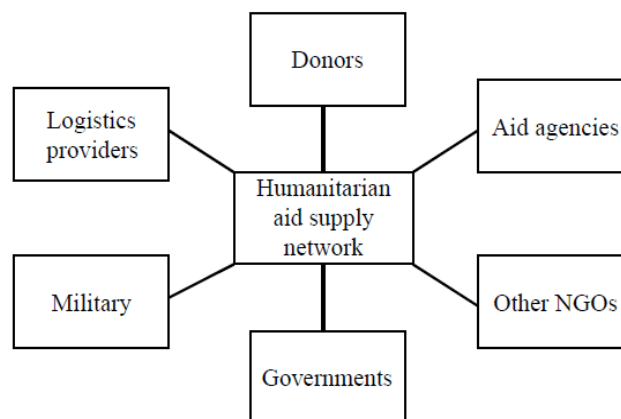


Figure 5. Actors in the Supply Network of Humanitarian Aid
(From Kovacs & Spens, 2007)

3. Humanitarian Logistics

Although humanitarian logistics did not receive much interest from practitioners and logistics academics prior to the Asian tsunamis in 2004, the element of logistics in humanitarian aid has always been an important aspect in conducting HA/DR operations (Kovacs & Spens, 2007). Apte and Yoder (2011) compared humanitarian logistics to commercial logistics, since logistics play a crucial role in nearly all aspects of society.

Basic elements that are common to both humanitarian logistics and commercial supply chain logistics include the following: supply, inventory, distribution network, flows, lead-time, information systems, customers, and demand (Apte, 2009). The basic principles of managing the flow of goods, information, and finances from final customers are similar for both humanitarian logistics and commercial logistics (Kovacs & Spens, 2007). The main difference is that humanitarian logistics tend to demand zero lead-times and flexibility when operating in a disaster area (Apte & Yoder, 2011).

Kovacs and Spens (2007) also noted that the speed of humanitarian aid after a disaster depends on the know-how of logisticians to procure, convey, and receive supplies at the location of a humanitarian relief effort. Humanitarian logistics encompasses disaster relief as well as continuous support for developing regions and characterizes the different operations that arise at different times due to various catastrophes. The distinctive differences between humanitarian logistics in disaster relief operations and business logistics are summarized in Table 1 (Kovacs & Spens, 2007).

Table 1. Characteristics of Humanitarian Logistics (From Kovacs & Spens, 2007)

	Humanitarian logistics
The main aim	Alleviating the suffering of vulnerable people
Actor structure	Stakeholder focus with no clear links to each other, dominance of NGOs and governmental actors
3-phase setup	Preparation, immediate response, reconstruction
Basic features	Variability in supplies and suppliers, large-scale activities, irregular demand, and unusual constraints in large-scale emergencies
Supply chain philosophy	Supplies “pushed” to the disaster location in the immediate response phase. Pull philosophy applied in reconstruction phase
Transportation and infrastructure	Infra-structure destabilized and lack of possibilities to assure quality of food and medical supplies
Time effects	Time delays may result in loss of lives
Bounded knowledge actions	The nature of most disasters demands an immediate response, hence supply chains need to be designed and deployed at once even though the knowledge of the situation is very limited.
Supplier structure	Choice limited, sometimes even unwanted suppliers
Control aspects	Lack of control over operations due to emergency situation

4. Crisis Prediction Management Software

Since the end of the Cold War era, military missions involving humanitarian assistance have increased, but the response to disasters has been ineffective and inefficient. The inability to estimate structure damage and to plan disaster relief resources was evident after Hurricane Andrew struck Miami-Dade County, Florida, in August 1992, thus pressing Senator Barbara Mikulski to request a federal-level review (Kehlet, n.d.). As a result, the U.S. Defense Threat Reduction Agency (DTRA) and the U.S. Federal Emergency Management Agency (FEMA), in conjunction with the Science Application International Corporation (SAIC), have developed the computer system known as the Consequences Assessment Tool Set (CATS; Kaul, n.d.).

CATS is an analytical software tool that assesses the consequences from natural disasters, such as hurricanes and earthquakes, and technological disasters, such as industrial accidents, terrorism, and acts of war (Samuels, 2009). CATS provides damage prediction models as well as casualty and damage assessment tools. To allow a wide range of consequence assessments, CATS links the damage prediction models and databases in a geographic information system (GIS; Swiatek & Kaul, 1999). The conceptual view of CATS is nicely illustrated in Figure 6 (Kehlet, n.d.). CATS helps emergency managers to train, exercise, plan, and prepare, and to calculate requirements for humanitarian aid (Samuels, 2009). The CATS system can be used to detect the following:

- roadblock distributions,
- population and infrastructure at risk,
- atmospheric plume footprints,
- locations and resources for disaster recovery, and
- blast effects (Samuels, 2009, p. 1).

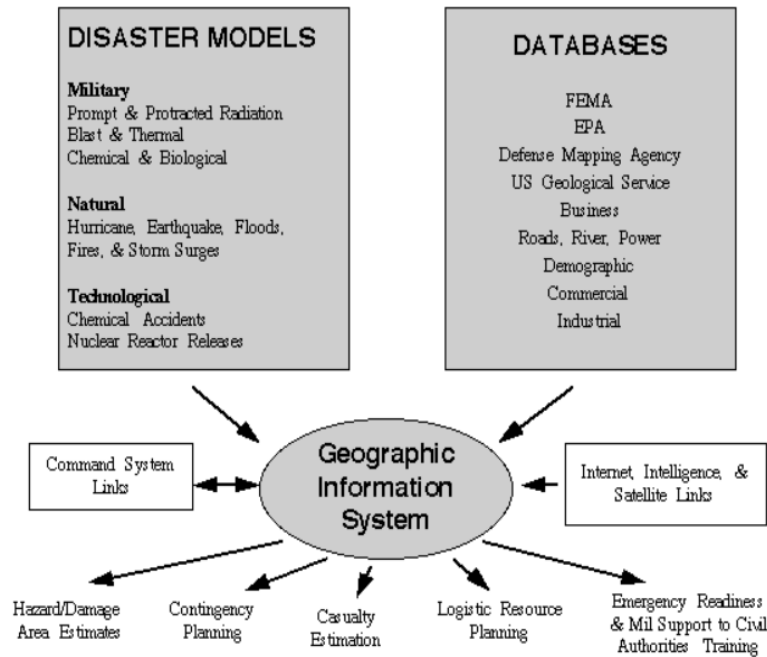


Figure 6. The CATS Concept (From Kehlet, n.d.)

To protect against natural and technological hazards, the CATS system takes real-time data from local meteorological stations and follows the steps listed in the following bulleted lists.

Before disaster strikes, the CATS system

- crafts simulation scenarios for training and planning,
- constructs contingency plans with CATS infrastructure and population data, and
- tracks hurricane and flood damage.

When disaster strikes, the CATS system

- assesses the affected populace immediately and accurately,
- assesses the damage from the National Hurricane Center (NHC) reports,
- reduces response time, and
- identifies roadblock locations and safe routes.

After disaster strikes, the CATS system

- assesses the facilities, infrastructure, and population at risk and finds resources for a continued response;
- gathers information for reporting, damage assessment, and lessons learned; and
- gains support for remediation and compensation (Stevens, 2011).

Since its inception, the credibility of the CATS system has been proven by its success in the playing field (Swiatek & Kaul, 1999). The CATS system supports emergency managers with an effective, operative resource to quickly respond to natural and technological disasters (Kehlet, n.d.). The CATS system is operational at many locations at the federal and state level and within the Department of Defense (DoD), as seen in Table 2 (Swiatek & Kaul, 1999). Table 3 exhibits numerous exercises, military operations, and demonstration conferences that employed the CATS system (Swiatek & Kaul, 1999).

Table 2. CATS Operational Locations (From Swiatek & Kaul, 1999)

Agency Type	Agency Name
Military	Corps of Engineers Defense Threat Reduction Agency Directorate of Military Support Forces Command National Ground Intelligence Center U.S. Pacific Command Pacific Disaster Center U.S. Marine Corps (Camp Lejeune) U.S. Southern Command
Government	Federal Bureau of Investigation Federal Emergency Management Agency State and Local Governments National Guard RAID Teams Alabama Emergency Management Agency (EMA) Colorado EMA Utah CEM New York City EOC Presidential Infrastructure Protection Task Force
Commercial	USAA Insurance

Table 3. CATS Exercises and Operations (From Swiatek & Kaul, 1999)

Humanitarian Allied Forces 98 (U.S. SOUTHCOM)
Blue Advance 98 (U.S. SOUTHCOM)
Joint Battle Center HA/DR (U.S. PACOM)
Brave Response 98 (U.S. PACOM)
Interagency Chemical Exercise 98 (NYC)
Hurricanes Georges/Mitch
(U.S. SOUTHCOM)
NATO 50th Anniversary Celebration
RESPONSE 95, 96, 98
Atlanta Olympics
CUSEC Ellipse Charlie G8 Summit
Ill Wind
JWID Makani Pahili
Pacific Horizon (Java) U.S. Marine Corps CBIRF
State Exercises: CO, FL, HI, NY, OR

B. THE MILITARY IN DISASTER RELIEF OPERATIONS

1. Legal Authorization for Military Disaster Relief Operations

The DoD is a key resource in response to both domestic and international disasters. The authority to utilize DoD assets nationally comes from the Robert T. Stafford Disaster Relief and Emergency Assistance Act (RSDREA, 2007). This act authorizes the president to make available a wide range of federal aid to states that are affected by natural or man-made disasters (Elsea & Mason, 2008). The use of military assets for U.S. civil support is referred to as defense support of civil authorities (DSCA). DoD Directive 3025.18 (DoD, 2012a) established policy and assigned responsibilities for the DSCA. DSCA is initiated by a written request from civil authorities, or qualifying entities, or by authorization from the president or secretary of defense. All requests are evaluated for their legality, lethality, risk to DoD forces, source of funding, effect on the DoD budget, appropriateness, and impact on DoD readiness to perform its other primary missions. However, federal military commanders do have immediate response authority if time does not permit and imminent conditions are present that do not allow for the normal approval channel to operate. Upon request for assistance by civil authorities, military commanders may provide an immediate response by employing their resources to save lives, prevent human suffering, or mitigate property damage within the U.S. (DoD, 2012a).

With disasters occurring internationally, DoD Directive 5100.46 (DoD, 2012b) sets policy and responsibilities for foreign disaster relief (FDR) operations. The directive states that the “DoD shall respond to foreign disasters in support of the U.S. Agency for International Development (USAID) pursuant to Executive Order 12163 and section 2292(b) of title 22, U.S.C.” (DoD, 2012b, p.1). This assistance can be provided only when directed by the president; when the secretary of defense, with concurrence of the secretary of state, approves; or when there is an emergency situation that requires immediate action to save human lives and time does not permit for the formal authorization process (DoD, 2012b). The primary means for the U.S. government to provide foreign humanitarian assistance (FHA) is not its military forces. The organization, structure, and readiness of the military enable it to respond rapidly and effectively when time is of the essence, but U.S. military forces normally supplement the activities of government authorities, NGOs, and intergovernmental organizations (IGOs). The U.S. Agency for International Development (USAID) is the principle agency for humanitarian assistance. The assistance provided by the military is designed to supplement or complement the efforts of the agencies or host nation civil authorities that have the primary responsibility for humanitarian assistance and is intended to be limited in scope and duration (Joint Chiefs of Staff [JCS], 2009).

2. Military Resources and Organization

In their supplementing or complementing role, military forces provide capabilities that include prompt aid to alleviate suffering of disaster victims, preparation and transportation of nonlethal excess property to foreign countries, transfer of DoD supplies in response to unplanned emergencies, and transportation of humanitarian and relief supplies. U.S. forces are an important resource for these missions because of their operational reach that improves initial response and their capabilities in logistics, command and control, communications, and mobility. The types of FHA missions that U.S. military forces normally conduct span a wide range of military operations but most often center around crisis response and limited contingency operations. These missions include relief missions, dislocated civilian support missions, security missions, technical assistance and support functions, and foreign consequence management. Relief missions

are normally the responsibility of NGOs and IGOs, but when these organizations are overwhelmed or are in a threatening security environment, U.S. military forces may be tasked for immediate response to prevent loss of life and destruction of property, construct sanitation facilities and shelters, and provide food and medical care. Dislocated civilian support missions are also typically conducted by the United Nations (UN), IGOs, or NGOs, but may be delegated to military forces; such missions include camp organizations, provision of care, and placement. Security missions include establishing and maintaining conditions for the provision of FHA (e.g., seaports, air terminals, roads, railways, secure storage areas) and providing protection for relief personnel. Technical assistance and support functions that the military may provide are communications restoration, port operations, emergency medical care, relief supply distribution management and delivery, search and rescue, base operating support, and humanitarian de-mining assistance. Foreign consequence management missions involve support to mitigate the effects of a chemical, biological, radioactive, nuclear, or high order explosives (CBRNE) event and to restore essential government services (JCS, 2009).

Once it is determined by the president that a U.S. humanitarian response is required for a foreign disaster, the National Security Council (NSC) directs the special coordinator for international disaster assistance to convene an International Development and Humanitarian Assistance NSC Policy Coordination Committee (PCC). The PCC then develops the comprehensive strategy for emergency response and the tasks for each key participant. Military operations, to include FHA for FDR, are directed by the CCDR that is assigned to the AOR (JCS, 2009).

The globe is divided into six geographical commands, each with a CCDR responsible for all aspects of its assigned missions. These commands are U.S. Africa Command, U.S. Central Command, U.S. European Command, U.S. Northern Command, U.S. Pacific Command, and U.S. Southern Command. These commands are usually the first military responders in FDR operations and provide an organized response (DoD, 2011).

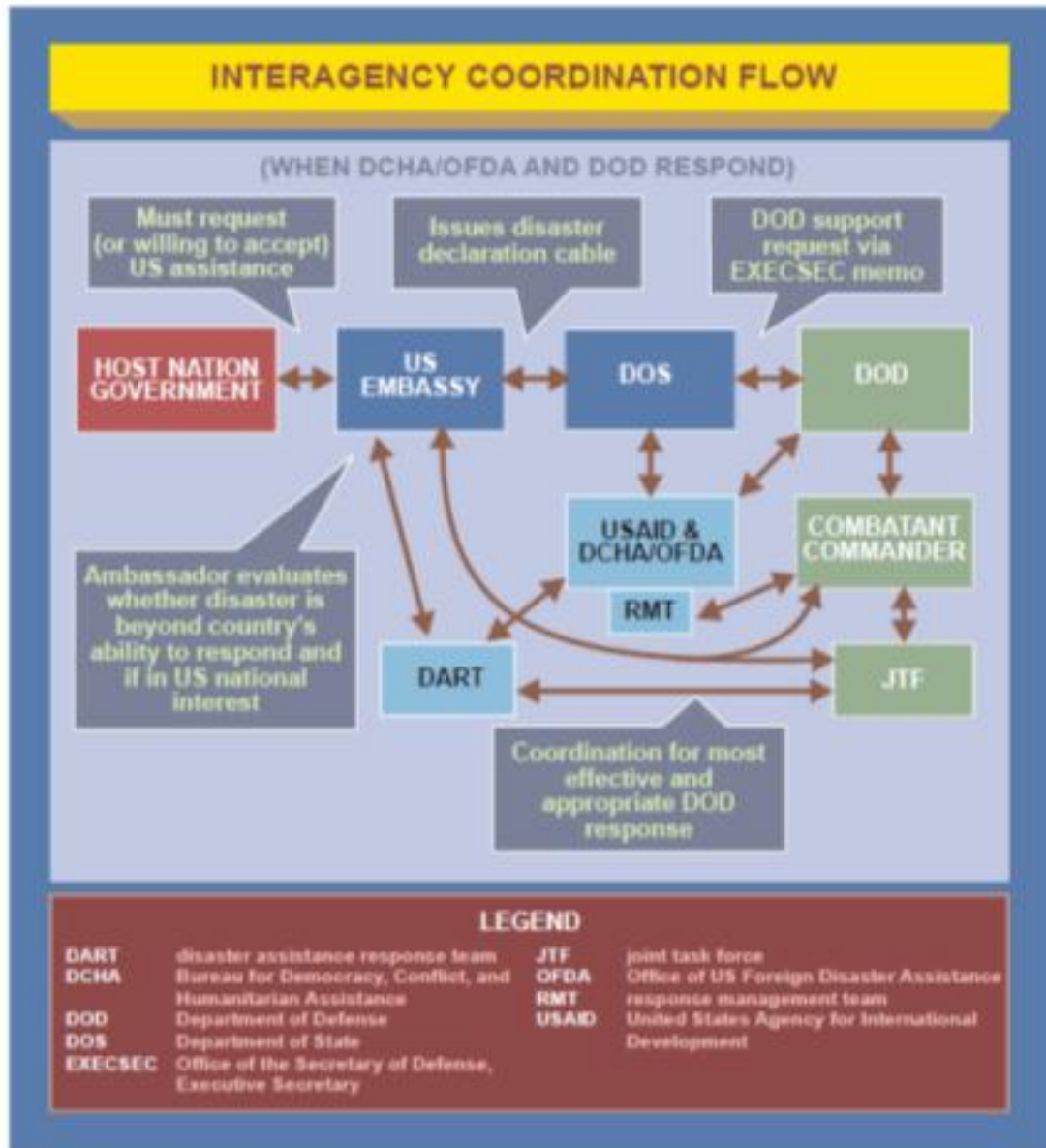


Figure 7. Interagency Coordination Flow (From JCS, 2009, p. II-6)

The CCDR structures the force necessary to conduct and sustain humanitarian assistance operations, usually by forming a joint task force (JTF). Advising the CCDR are the Department of State foreign policy advisor and USAID senior development officer, who provide nonmilitary insights and enhance direct communications and coordination with the affected embassy and country team. The crisis action or rapid deployment team that each CCDR possesses is initially deployed to respond to and assess the situation for the commander and may recommend assistance in the form of funding,

material, or technical assistance. The CCDR may also organize a humanitarian assistance survey team (HAST) to acquire planning information by assessing the capability and capacity of the host nation's government to respond to the disaster. The HAST identifies primary points of contact for coordination and collaboration, assesses the threat environment, and coordinates for the delivery of food and medical supplies with specific support arrangements (JCS, 2009).

Additional assets and resources that the JTF may use to coordinate and facilitate the FDR response are civil-military operations centers, humanitarian assistance coordination centers, and liaison officers. Depending on the type and severity of the disaster and on the restrictions emplaced by the host nation, the exact composition of these assets and resources will vary. It is up to the CCDR to determine the composition necessary to best utilize available assets (DoD, 2011).

3. Military Capabilities in Disaster Relief

Organizational commands below the CCDR provide support to the JTF in accomplishing FDR operations. For example, the U.S. Special Operations Command capabilities include the ability to establish and control the air-ground interface. This command assesses and establishes landing zones, air traffic control, command and control communications, and coordinates the destruction of obstacles. Military Information Support Operations (MISO) personnel provide the ability to communicate information via radio, television, leaflets, and loudspeakers to large audiences. These personnel are also knowledgeable in language skills, regional orientation, and communications media (DoD, 2011).

The overall logistic concept is closely integrated and mutually supports the operational strategy of the FHA mission. A key element that the CCDR or joint task force commander (JFC) considers when carrying out the planning and execution of FHA missions is locating logistic bases as close as possible to the relief recipients. In major population centers, measures are taken to establish logistic bases that prevent moving the recipients from their economic and social areas. All potential supply sources are considered, including the affected country's supplies and any commercial, multinational,

and pre-positioned supplies (JCS, 2009). The ability of the JTF to rapidly distribute these supplies, especially in isolated areas, is critical to the success of disaster relief operations (DoD, 2011).

The capabilities available to U.S. military forces to facilitate humanitarian operations include rapidly deployable ground transportation, aerial transport and flight operations, operationally flexible maritime forces, engineering abilities, full communications capabilities, full medical services, civil affairs support, and area security (DoD, 2011). The JTF contains the units necessary to accomplish these capabilities or, through the CDR, has the ability to acquire them as needed.

The U.S. Army and Marine Corps possess ground transportation units to facilitate the distribution of supplies and movement of personnel. The ground transportation options include medium- and heavy-lift transport trucks, material handling equipment such as forklifts, and the personnel to operate them. This capability allows for the loading, off-loading, transfer, and distribution of supplies in a rapidly deployable manner (DoD, 2011).

Aerial transportation is available through all U.S. military Services. DoD aviation assets typically provide the majority of aerial support during disaster relief operations. From the mass cargo-carrying ability of the large transport planes to the image-producing abilities of unmanned aircraft, the military is able to cover the gamut of diverse and necessary missions in relief operations. These include the intra-theater airlift of cargo, medical evacuation, aerial assessments, personnel transport, population evacuation, firefighting, airspace management, command and control, search and rescue, and personnel recovery (DoD, 2011).

Maritime forces significantly reduce the footprint of assets ashore and minimize the required permissions to operate from the host nation while providing operational flexibility and assured access. The forward deployed nature of the U.S. Navy's amphibious ships, with their embarked expeditionary Marines, allows for an immediate response capability across the globe. With its comprehensive communications capabilities, ground units, aviation forces, and personnel, the amphibious force is able to

respond immediately with almost all necessary assets for FDR operations and is capable of self-sustaining those capabilities for 15 days without a shore infrastructure (DoD, 2011).

The U.S. military's engineering capabilities bring the necessary capabilities to restore structure to a post-disaster area. Military personnel assess damages and needed repairs and assist in providing power supply and distribution, utilities repair work, water purification, and well drilling. Engineering units are capable of providing facility construction, structural repair, camp construction, and cleanup. They possess the equipment to deal with debris removal (e.g., mud, dirt, trees, and concrete), road and bridge construction, shelter construction, power generation, and fire suppression (DoD, 2011).

A key ability in FDR operations is communication. U.S. military assets possess a full suite of communication capabilities. These assets include line-of-sight, over-the-horizon, and satellite communications systems for voice, video, and data and may be the only communications infrastructure. This means military assets will be heavily relied upon by the host state and all relief organizations (DoD, 2011).

Another key capability that U.S. forces bring to FDR operations is medical care. Medical care may be requested to augment or sustain the host state in order to save lives and minimize suffering. The U.S. military is capable of providing emergency treatment, triage, surgery, pharmacy, physical therapy, dental treatment, and administrative and logistical services. The military can provide ground and air medical evacuation, veterinary services, logistics for medical supplies, and preventive medicine. The military is also capable of providing patient transport and, as may be necessary in disasters, assistance in mass fatality management (DoD, 2011).

The JTF possesses civil affairs units that provide personnel with culturally oriented and linguistic capabilities. These personnel can provide emergency coordination and administration capabilities when civilian political/economic structures with the host state have been rendered unusable. They have a great amount of knowledge in operations between civilian and military entities in permissive environments. Their core tasks are to provide support to civil administration and to provide populace and resources control,

disaster relief, and management of civil information. Their functional specialty areas include rule of law, economic stability, governance, public health and welfare, infrastructure, and public education and information. The civil affairs units are the advisors to the JFC on the impact of military activities within the civilian sector (DoD, 2011).

Force protection should be provided by the host state of the disaster. In some cases, however, U.S. military forces may be requested to assist with security. These forces may also be crucial for providing protection for the joint force and security for both victims and relief workers. Specific forces are also capable of assisting in force protection if an environment changes from permissive to uncertain or hostile. Military forces have the inherent right of self-defense and the responsibility to protect themselves and military assets at all times (DoD, 2011).

While not the primary U.S. government means of providing FHA, the foreign assistance that U.S. military forces are tasked to provide is designed to supplement or complement the efforts of the host nation's civil authorities and agencies that have primary responsibility for assistance. The U.S. military is capable of quickly reducing the human suffering, disease, hunger, and privation brought on from disasters. U.S. forces have the unique assets for effective response and play a key role in foreign humanitarian crises (JCS, 2009).

C. ADVANCEMENTS IN TECHNOLOGY IN SUPPORT OF HA/DR

1. Disaster Classification

To better understand the different methods of delivering humanitarian assistance and disaster relief, it is important to understand the definition of *disaster* and categorize the different types of disasters so that implementation of relief can be at its most efficient. Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (RSDREA, 2007), a major disaster is any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought) or, regardless of cause, any fire, flood, or explosion. However, this definition is only applicable to disasters that occur in the United States (RSDREA, 2007). Will, Chinowsky, and Senesi (2010) defined *disaster*

quantitatively. For an event to be declared a disaster, it must meet all of the following requirements: at least 100 human deaths, at least 100 human injuries, and at least U.S.\$1 million in economic damages (Will, Chinowsky, & Senesi, 2010; FEMA, 1990).

This definition gives rise to interesting situations of what classifies as a disaster. When Hurricane Katrina hit, there was substantial damage and loss of human life. Damages were estimated at more than U.S.\$1 million, and the situation was designated a disaster by the president of the United States. However, when a plague that could equate to 100 human lives hits a small African village, it is not reported as a disaster.

FEMA defines a disaster as an occurrence that has resulted in property damage, deaths, and/or injuries to a community (FEMA, 1990). FEMA also defines it based on its characteristics (FEMA, 1990). Disasters can include any one event that

- creates demands that exceed the normal capacities of any one organization and/or government;
- crosses jurisdictional boundaries;
- disables the routine equipment and facilities needed for emergency response;
- compounds the difficulty of understanding “who does what” in disaster response due to the complexity of governments; and
- is impacted by a lack of standardization in disaster planning and response and complicated coordination in a time of disaster (FEMA, 1990).

FEMA’s definition of a disaster is more helpful for military leaders, civilian organizations, and logisticians because it offers a better description of a disaster, its implications on the surrounding populace, and the response efforts of organizations and agencies. Going back to the previous example of Hurricane Katrina, hurricanes and weather anomalies can be tracked by meteorologists to provide advanced warning to save human life and mitigate damages to the surrounding area. A plague or famine normally arrives with little or no warning and shows just how important operational procedures and logistical coordination are to providing immediate response. Both scenarios—one that can be planned and one that is spontaneous—require consistent communication from military and civilian organizations and a logistics structure to efficiently allocate resources and supplies to affected areas.

Apte (2009) offered a classification approach for disasters that represents an analysis of time versus location and the level of difficulty that arises. Figure 8 shows that as the time of the disaster's onset changes (slow onset to sudden onset) and locations change (from localized to dispersed), the level of difficulty for disaster response increases. Disasters that occur over a period of time or disasters with a slow onset provide time for humanitarians to plan and prepare for relief operations. However, disasters that strike swiftly can pose challenges for response organizations since no organization—military or civilian—can optimally prepare for the disaster. Strategic planning of assets and facility locations may help, but it is the timeliness of the response that matters (Apte, 2009).

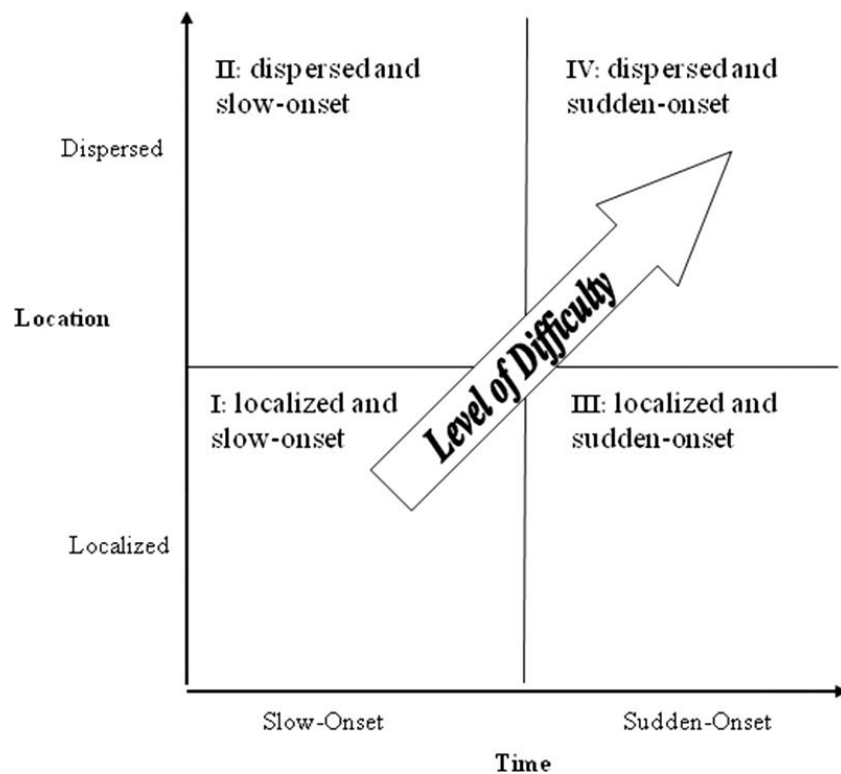


Figure 8. Classification of Disasters (From Apte, 2009)

This model can help organizations, military services, and logisticians with categorizing common disasters (dispersed, localized, slow-onset, sudden-onset) and minimize response time by classifying the level of difficulty of disaster response by quadrant.

2. Technology Software through the Years

After each major disaster of the modern era, organizations and agencies have reaffirmed a critical lesson: good communication is essential to effective coordination (United Nations Foundation [UNF], 2011). Networks that are designed to connect HA/DR leaders have grown in the past, increasing the volume of data available about the surrounding area with few to no methods for compiling that data into useful information. Responders that have arrived on-scene are less than prepared to use the data given to effectively manage resources and supplies. Thirty years ago, humanitarian operations were managed with push-to-talk radios, paper forms on clipboards, and push pins on paper maps. Since that time, the field has undergone a revolution (UNF, 2011). Today, cloud computing, text messaging, virtual telephone conferences, digital map displays, electronic data collectors, and sensors and super computers are making sharing and compiling data, processing data into accessible information, and displaying information on easy-to-read maps a thing of the past. Figure 9 depicts an example of an integrated communication system and the importance of disaster communication media during pre- and post-crisis response.

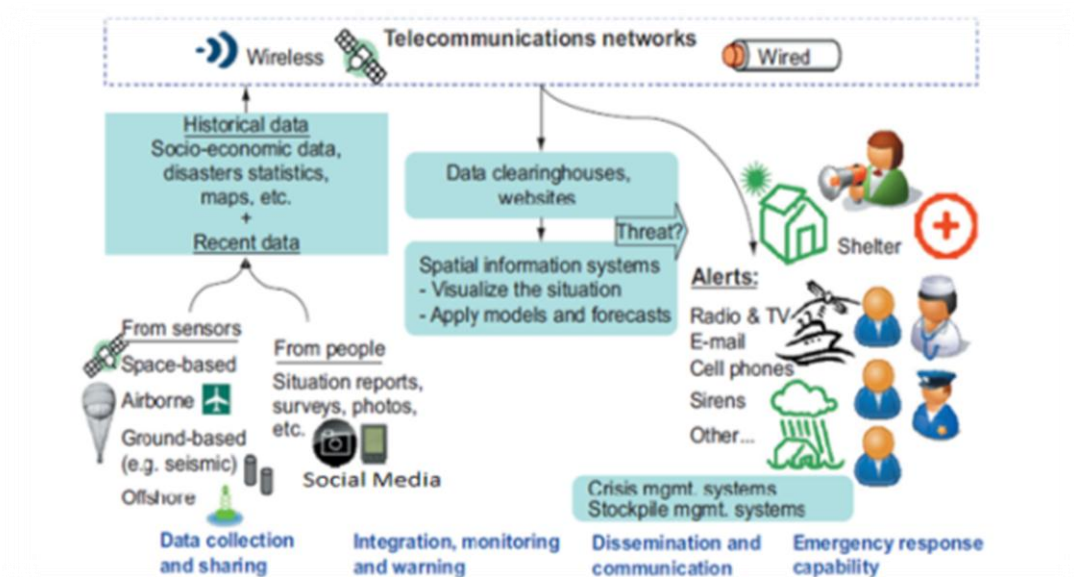


Figure 9. Example of Integrated Communications Infrastructure (From United Nations Economic and Social Commission for Asia and the Pacific [UNESCAP], 2009)

Natural disasters can create severe working and living conditions that subsequently create a unique challenge to military and civilian first-time responders. In his NPS masters' thesis, Ramsey Meyer (2011) stated that “even the systems that should be the most reliable are often knocked offline, such as the voice radio networks used by police, fire, [and] emergency medical services (EMS)” (p. 7). Establishing communications, sharing information, and understanding the logistics capabilities of a nation post-crisis are keys to saving lives and providing relief. Modern advances in technology have been critical in saving lives, including the capability of WiFi clouds and satellite uplinks to share data and provide response teams with critical information about the area. Also, advancements in social media (e.g., the capability to upload videos on YouTube, post updates on Twitter and Facebook, and take photos by cell phone) have helped many first-time responders to understand the environment before their boots ever touch the ground. There are many lessons still to be learned about the response efforts after the earthquake in Haiti. Figure 10 depicts the system enterprise architecture that was established during response efforts in Haiti and that helped relay information from responders in the field by using cell phone service and instant messaging in the field (Teasley, Covi, & Olson, 2000).

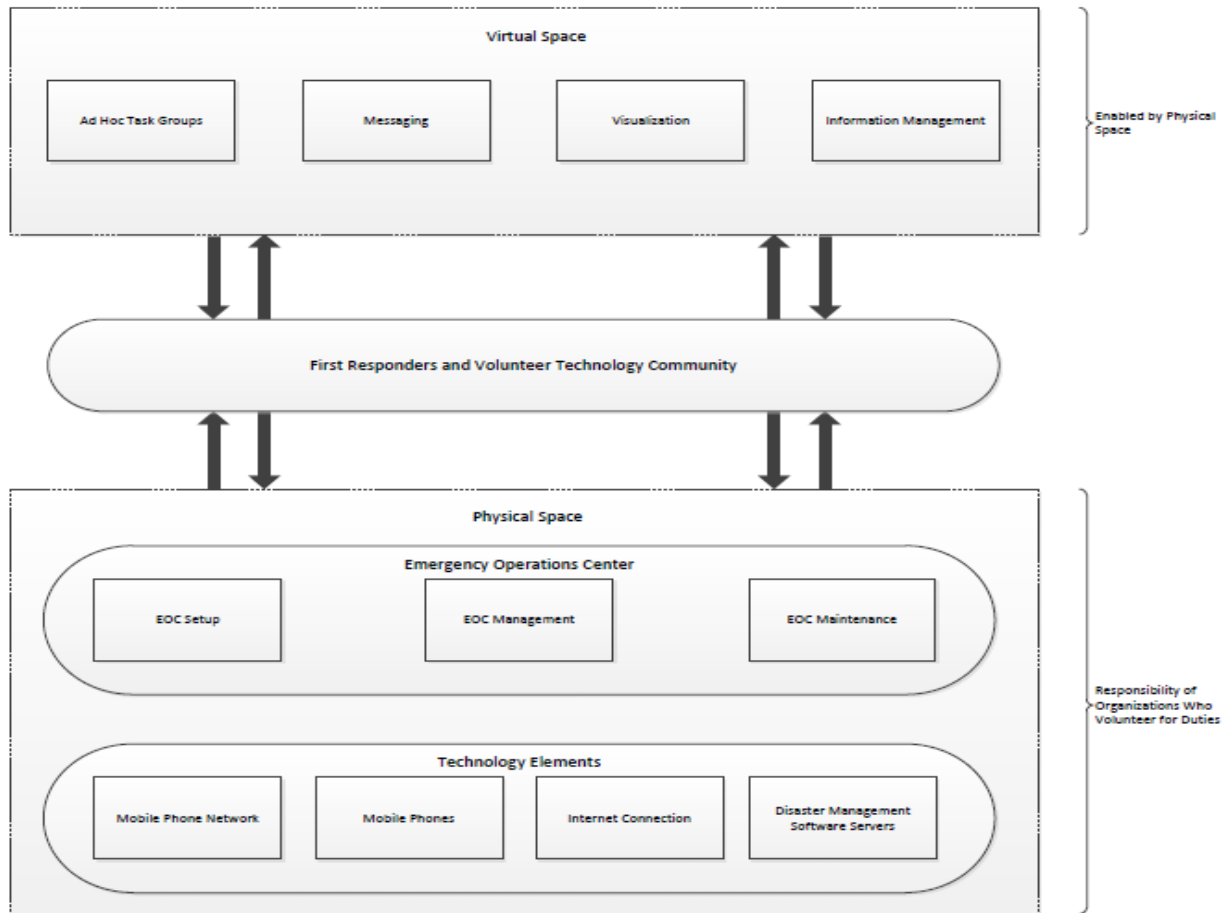


Figure 10. System Enterprise Architecture (From Teasley et al., 2000)

Meyer (2011) also stated in his thesis that many successful humanitarian software projects exist as completely volunteer-staffed efforts, and there is no reason why software packages could not be supported by a group of self-organized and dedicated tech-savvy programmers. With technological advancements that make media sharing easier and that do not always rely on hard-line connections and reliable electricity, a data-collecting software that could easily store information and relay it to decision-makers will help save lives and provide a faster recovery for the area in crisis. Meyer (2011) suggested that with disaster relief software in place, emergency operations center (EOC) tents could be useful for relaying information from the responders in the field to organizations providing the relief. Figure 11 is an example of how these EOC tents would be set up (Meyer, 2011). This software would also benefit military and civilian organizations before responders

even arrive on location. Data-sharing capabilities from social media outlets, electronic resource collection devices, and a nation's own data inputs could provide military and civilian responders with a clear picture of the environment and provide ongoing service when responders enter the field.

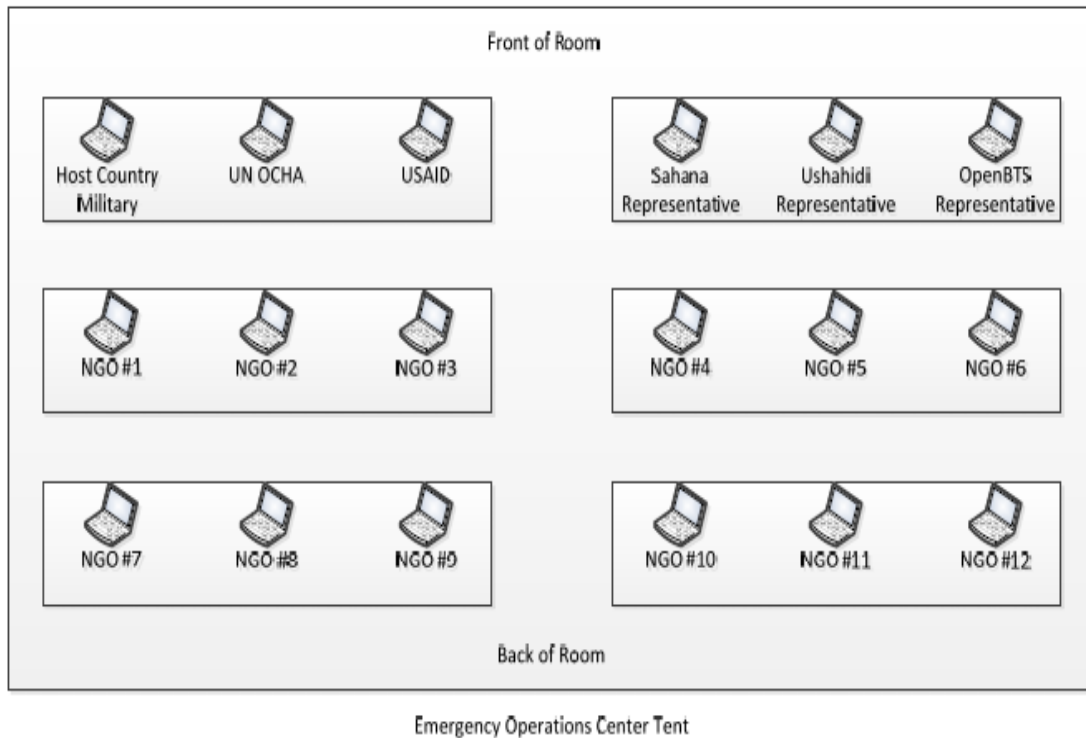


Figure 11. Emergency Operations Center Tent (From Meyer, 2011)

Reliable sharing of information is necessary during the response to a disaster, but what is more important is ensuring that the information gets to the right decision-making leaders quickly in the affected AORs. The Internet, computer software, and decision-assisting programs have aided responders by integrating with multinational organizations' data-sharing capabilities and have created a global, operational information hub that leaders can refer to when coordinating resources. The United States Navy unveiled its latest web-based tool, known as RAST, in February 2012, and this tool will help responders manage resources during an international disaster (Office of Naval Research [ONR], 2012). RAST is discussed in more detail in Chapter IV.

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III. METHODOLOGY

A. DATA COLLECTION

The data collection method that was used for this research topic included collecting literature on HA/DR relief efforts from military organizations and civilian agencies. The researchers also collected data on information technology through the years and lessons learned from previous disaster relief efforts. These lessons learned, coupled with the advancements in technology, have impacted the growing need for decision-assistance tools. Since COCOMs are increasingly involved in foreign disaster response, many researchers are striving to improve methods in logistics and the management of resources. We used online databases and news archives to collect much of the findings presented in this research.

The collection of data for RAST was provided from briefs acquired from the COE-DMHA. Since RAST is a concept, the researchers could not use online databases and search engines. The majority of information collected from this decision-based tool came from our own involvement with the program, technical publications for the software, and the scenario that we reviewed. We also received usage information for RAST from conversations with Computer Sciences and Engineering Department representatives Jeremy Cohen and David Resseguie at the Oakridge National Laboratory in Oakridge, Tennessee.

To better understand the framework of the RAST concept, we began the project with an outside-to-inside approach to collecting data and applied a cause-and-effect analysis. Initially, we began by obtaining background information on the software to understand its interfaces with external input sensors. By understanding how the RAST gets its input data, we could better understand the output information displays and external forces that could benefit or cause issues for the software. We then moved on to categorizing the different functions and architecture of the software. By understanding the software architecture, the user (and researchers) has a better understanding of where pertinent information is located and how to best display and funnel that information to

decision-makers. This was an important step in our data collection due to the time sensitivity of important information. A user of RAST who does not understand the software architecture (cause) can cause significant time delays and prevent decision-makers from most efficiently managing resources that could cost lives (effect). Finally, we ran a live PACOM-based scenario that allowed us to determine the effectiveness of RAST, identify issues with the software, and recommend best solutions for managing these issues. In Chapter V, we present these results and, in Chapter VI, we provide our recommendations for improvement of RAST. In Chapter VII, we provide follow-on research suggestions to continue with the RAST concept and its uses for HA/DR organizations and agencies.

IV. RAST

A. THE NEED FOR INNOVATION IN HUMANITARIAN LOGISTICS

1. Increasing Awareness of Disasters

One of the most important aspects that the DoD needs to consider when dealing with disaster and humanitarian response operations is to increase situational awareness of disasters. To increase situational awareness of disasters, it is important to understand the effects of climate change and how these climate changes increase disasters. McGrady, Kingsley, and Stewart (2010) defined both the disaster response and humanitarian response as response operations. Although it is hard to forecast the exact number of new emergencies occurring due to climate change, it is possible to predict that there is an increased number of rapid-onset disasters due to climate change. In their report, McGrady et al. (2010) remarked that climate change increases the demand for military forces, changing the military requirements to assist in disaster relief efforts. Figure 12 depicts the relationship between climate effects and HA/DR response and how these changes affect U.S. policy-makers' decisions to commit military forces.

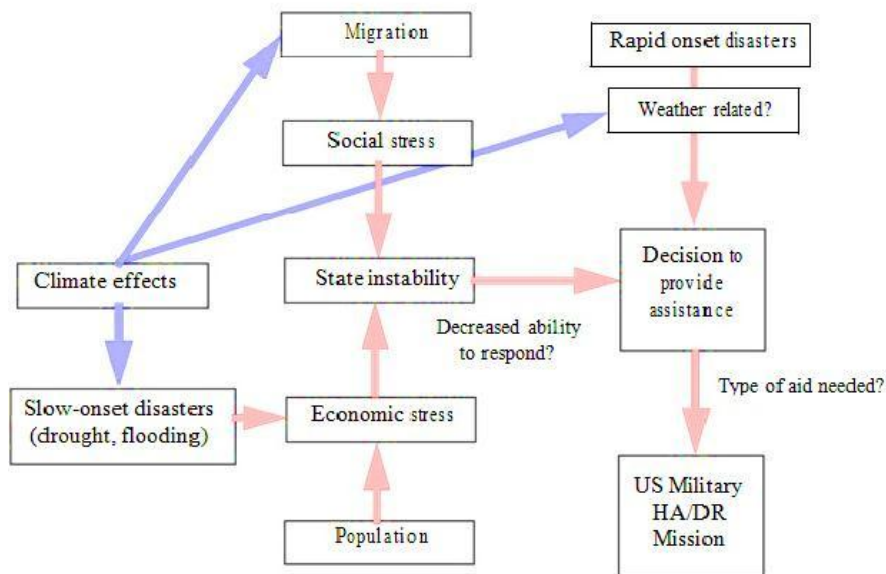


Figure 12. Relationship Between Climate Effects and U.S. HA/DR Response
(From McGrady et al., 2010)

Climate change may alter the nature of the disaster, the type of disasters we respond to, the political rationale for responding, and the security context. Changes in these rapid-onset disasters construct changes in response missions, and these changes in missions are divided into three categories: evolutionary, emergent, and revolutionary.

- **Evolutionary.** Missions the DoD currently performs, but will do more often in the future.
- **Emergent.** Missions we currently do not perform frequently, but may in the future, due to increased intensity or risk from the disaster.
- **Revolutionary.** Missions that are not even possible or contemplated in a world without climate change, such as a response to a climate change cause itself. [(McGrady et al., 2010)]

The common evolving missions that the military currently responds to include: tropical cyclones, flooding, volcanoes, and earthquakes. Any increase in the frequency or intensity of those events will cause the U.S. military to perform these types of mission more frequently. Fire is an example of an emerging mission we currently face due to its potential to produce atmospheric carbon, thus changing the type of disasters that occur. In addition to new missions emerging, climate change may alter the priorities and distribution of military forces. For example, governments may task firefighting to the military either because it is an emergency or because the carbon emissions may increase global warming. It is important to note that increased frequency of climate effects increases the social and economic pressure, thus resulting in an increased need for military forces as part of the response (McGrady et al., 2010).

2. DoD's Strategy With HA/DR

The DoD has increased its awareness of the importance of HA/DR operations through instructions such as DoD Instruction (DoDI) 3000.05, which states that stability operations to include humanitarian assistance, shall be a core U.S. military mission. Humanitarian assistance will not be an individual effort by any one branch or Service, but will be an effort by all Services, departments, and agencies that fall under the DoD. This instruction for providing stability operations requires that the DoD be able to provide capabilities and capacity to provide HA/DR operations when required. For relief efforts that will be needed overseas, the DoD's strategy for providing relief operations will

include working with foreign governments, international government organizations, and security forces. The DoD plans to work to establish civil security and civil control, restore essential services, repair and protect critical internal infrastructures, and deliver humanitarian assistance until such time as it is feasible to transition lead responsibility to other U.S. government agencies, foreign governments and security forces, or international governmental organizations (DoD, 2009).

DoD Instruction 3000.05 also points out the importance of civil-military operations when conducting relief efforts either in the continental U.S. (CONUS) or outside the continental U.S. (OCONUS). With the DoD's strategy for operating with multiple agencies—civilian and military—and working with foreign governments, the capability to communicate and keep all players on the same page is critical. Technology and communication tools will become key components for mission success while multiple agencies and departments are conducting HA/DR efforts. By showing the efforts being provided by the responding organization and what is still needed for the country in distress, technology and communication tools will help ensure that resources are being used efficiently, timeliness of relief efforts is optimal, and synergy is built among responding organizations. RAST could be the capable and scalable HA/DR tool that can implement the right people in the right places, that can work to restore critical services (potable water, electricity, etc), and that can help maintain civil security and control (DoD, 2009).

RAST, formerly known as The Resiliency Assessment and Coordination System (TRACS), accesses data from electronic sources such as the United Nations' ReliefWeb and Office for the Coordination of Humanitarian Affairs and displays it on a map-based diagram showing the locations of various resources, such as food, shelter, sanitation, and health supplies. RAST is being developed through a partnership between the Office of Naval Research (ONR) and the COE-DMHA to satisfy COCOM and military component requirements for disaster relief. The ultimate goal for the ONR and the COE-DMHA is to transition the RAST technology into large-scale use for the PACOM (ONR, 2012). In the next few subsections, we discuss RAST as it currently stands and may be utilized in the future.

3. Understanding the Critical Demand for RAST

In order to understand the function of RAST, we first need to understand the demand for RAST through the potential “customers” of RAST. When trying to define who the customers are that can benefit from this new HA/DR logistics capability, we define customer in two ways—the primary customer who is in charge of important decision-making and the secondary customer who is in the field or is responsible for updating RAST pre-crisis, during relief operations, and post-crisis. As represented in Figure 13, the secondary customer would be those individuals or organizations updating RAST with recent data and the primary customer would be those individuals or organizations using the information generated by RAST to determine the required response to the disaster and the management of those resources.

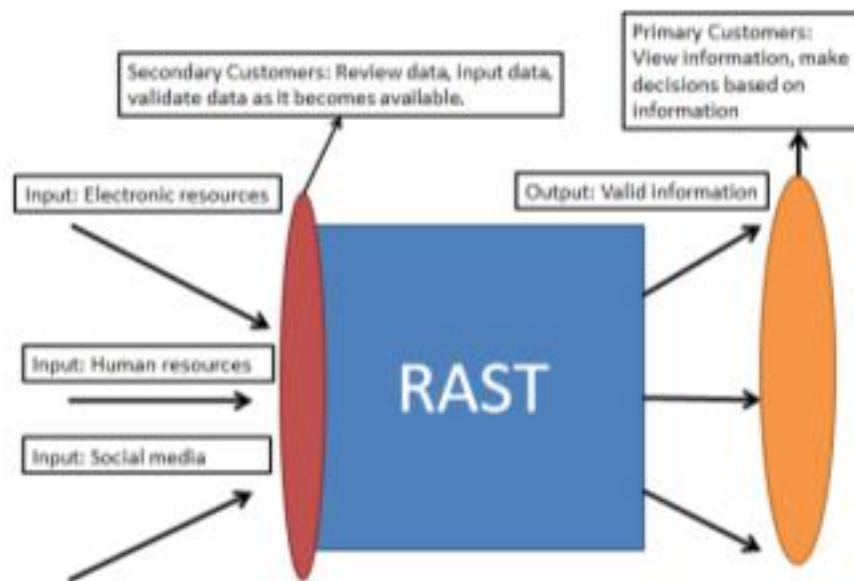


Figure 13. RAST in Relation to the Customer

To be more exact, primary customers can be any individual or organization responsible for providing and coordinating response efforts and, ultimately, making decisions about the employment of operations. In real world events, primary customers can be any military or civilian individual or organization. In the case of the scenario to be

covered in Chapter V, the primary customer would be the commander for PACOM who will be provided information gathered from data that has been input into RAST. The commander of PACOM will be responsible for the overall relief efforts from the strategic, operational, and tactical (in the field) levels in the implementation of resources to the area of concern.

To clearly define the secondary customers, they can be, but are not limited to being, a field agent, first responder, analyst for validation of data, potential user of RAST, etc. They are all the individuals who are responsible for the inputting of data, validation of data, and technical support of RAST. In real-world events, secondary customers can be any military or civilian individual or organization. In the case of the scenario to be covered in Chapter V, the secondary customer would be the first responders and field agents responsible for validating data and the accuracy of the previous data in RAST to better prepare for future operations in Nepal.

RAST can offer its primary customers the ability to develop strategies to provide adequate help to the victims of disasters. These strategies will be developed by having reliable real-time information that can be accessed and distributed for quick response. Due to the uniqueness of disasters, specifically the Southeast Asian tsunami in 2004, Hurricane Katrina in 2005, the earthquake in Haiti in 2010, and the earthquake in Japan in 2012, the ability to understand the pre-crisis and real time social, economic, and political infrastructures, and the availability of resources in the area, will help primary customers effectively employ their assets to provide relief and update the area affected as time progresses.

It is essential that customers strengthen their capacity to gather, share, analyze, and disseminate information so that manpower and military/civilian resources are used efficiently. For the secondary customers that operate in the field or the analysts updating RAST when a disaster hits, this tool can serve as a communication medium prior to resources being deployed into the area of concern. Since there is always a high likelihood that multiple nations will respond, it is imperative that a communication and data-sharing software such as RAST be used because of the large number of responses from a diverse field of organizations (foreign and domestic militaries, NGOs, private companies, etc.).

Such a tool can help ensure that countries use their resources to their fullest and see the affected areas that need their immediate attention.

Having a tool such as RAST that can be used on the strategic, operational, and tactical (in the field) levels during disaster responses is vital for ensuring the overall success of response efforts. In almost every disaster, one of the obstacles in providing an efficient response has been the inability to communicate effectively, the lack of a full understanding of the operational environment, and the inability to provide immediate logistic and supply relief to the affected areas. In the end, the time delays that occur because of this inefficiency can make the difference between life and death. RAST is meant to expedite decision-making by providing support. We will next discuss the capabilities of RAST.

B. CAPABILITIES OF RAST

As its fundamental capability, the RAST concept is to provide first responders with information to begin initial planning as well as a “common operating picture,” a big-picture view of relevant assets, for all critical players in HA/DR operations (ONR, 2012). RAST is built on the premise of establishing a common understanding for the action and collaboration of multi-national military and civilian partnerships. RAST can provide a working architecture for management and a common understanding of the disaster situation and the requirements necessary to fulfill the needs of the area under crisis. Figure 14 depicts an example of RAST’s capability to collect, filter, and organize information so that only needed information is provided to the user and information overload is prevented. Figure 15 shows the ability of the software to provide a common view (basic breakdown of critical needs that can be easily understood) by describing the response requirements of the affected area to organizations and agencies. Figure 16 portrays the unity of effect RAST provides by assessing progress and evaluating the restoration of the interdependent systems (i.e., social elements and economic impact) and the logistics requirements.

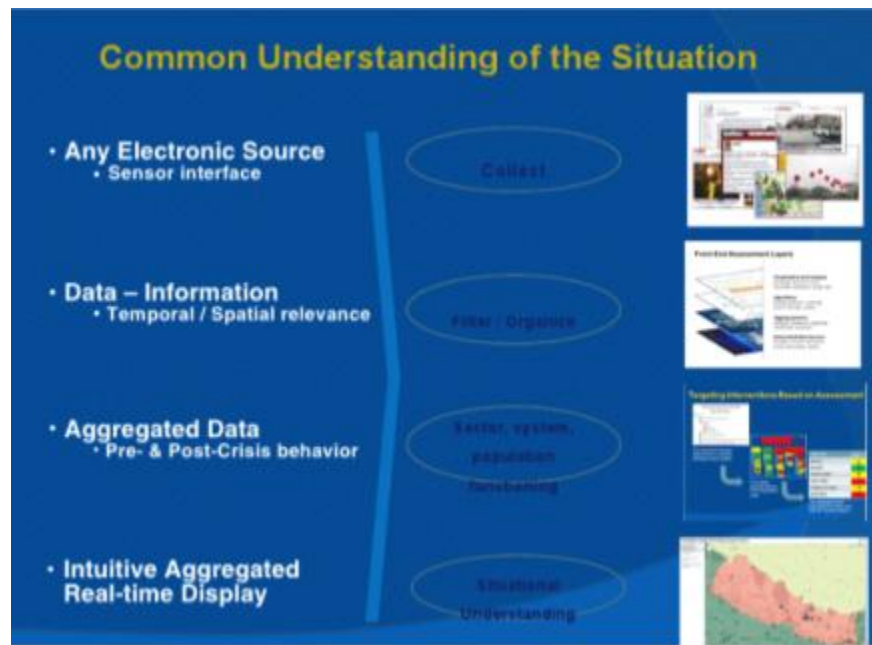


Figure 14. RAST Collection and Filtering of Information (From COE-DMHA, 2011)

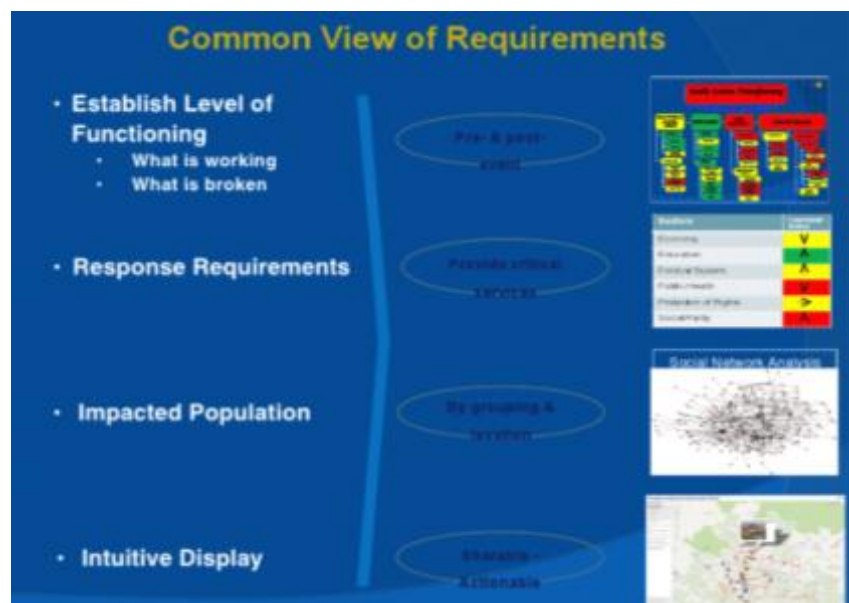


Figure 15. RAST View of Requirements and Display Capabilities (From COE-DMHA, 2011)

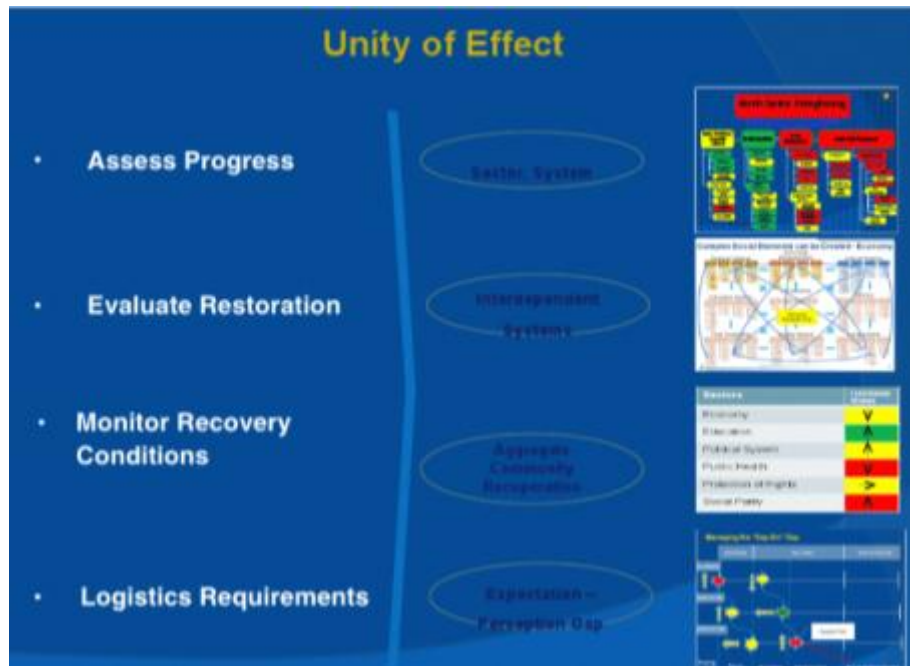


Figure 16. RAST Assessment of Progress and Logistics Requirements (From COE-DMHA, 2011)

RAST is currently in its design phase, but will hopefully be able to fuse a vast amount of information (e.g., images, resource inputs, local and national media that is being broadcast from the crisis) and display it in various formats to provide users with a dashboard-like at-a-glance view of the status of numerous assets and progression of relief efforts. RAST displays the affected areas in green (good), yellow (fair), and red (needs help). In the future, updates to RAST will show what needs to be fixed—and in what order—to turn a red item to green. Another tool that is planned to be added to RAST is the capability to feed social media inputs into the program (e.g., Facebook, Twitter, etc.). This will reduce the initial footprint of first responders by allowing them to arrive with only the items that are actually needed for a particular event and location (ONR, 2012).

Another great benefit of RAST is that it can be updated instantaneously from any electronic device that offers a portal to the Internet. This does not mean that RAST will be limited in its ability to update if a region or affected area has experienced a loss of electricity or does not have the capability of gaining a portal to the Internet. Advancements in modern technology to include satellite communications via telephone,

instant messaging (IM), SAT and Wi-Fi uplinks, cloud computing, and data storage can ensure that RAST will always display real-time information to customers both operationally and administratively. If field agents are not able to update RAST in the field, redundancy in relaying time-critical information will be initiated. Field agents will be able to communicate to emergency operation center tents (Meyer, 2011) via alternate electronic resources and their respective agencies or military branches will be able to populate data and upload it to RAST, ensuring that CCDRs will have real-time information in a dashboard view.

As efforts to provide relief to the affected country are undertaken, a color-coding scheme based on the country's infrastructure will be updated. This continuous flow of information will allow CCDRs and civilian agencies to see where they need to focus their efforts next to bring relief to affected areas. In Chapter V, we demonstrate how RAST may be utilized in the PACOM AOR.

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V. DISCUSSION

A. IMPLEMENTATION OF RAST IN NEPAL—PRE-CRISIS

1. Pre-Crisis View—Global View

First and foremost, it is important to clarify that the current setup in RAST of the country of Nepal is in no way reflective of the country's current infrastructure, nor is it reflective of the country's response to its own disaster relief capabilities. This scenario is strictly based on hypothetical assumptions and meant to show the capabilities of RAST. Figure 17 shows the RAST initial page in Global View that responders will see pre-crisis. It should also be pointed out that the current name on the program is still reflective of its previous name, TRACS.

The Resiliency Analysis and Coordination System (TRACS)



Figure 17. RAST Pre-Crisis

The country's color scheme is a critical communication tool and is indicative of the current economic, financial, social, and political infrastructure. The color scheme can be updated by outside agencies such as the World Health Organization, Department of State, and even the country's own organizations. RAST can be updated by Nepal (and outside agencies) to include categories such as Nepal's government and economy, water and sanitation treatment resources, and, some day, social media outlets. The ability to update this information will be shown in subsection 3 of this chapter. The color scheme is made available by identifying pillars of choice in the top left-hand corner of the RAST under Select Scoring Criteria. In Figure 17, all pillars are being viewed simultaneously to show the current country's infrastructure before a major crisis event. If the country is colored dark green, then the infrastructure is working at an optimal capability overall. As the colors progress from dark green to light green, from light green to yellow, from yellow to light red, and from light red to dark red, the infrastructure is becoming progressively more unstable and dependent on assistance. Nepal is currently working in a slightly optimal capability. While the analyst has "Global View" selected, the analyst will then select Display Country Layers in the top-right corner. This function will allow the analyst to see not only the color score of Nepal but also the resources that are available, locations of those resources, and the number of data sets that RAST has acquired to quantify the scoring of Nepal. Figure 18 shows the Display Country Layers function. The Display Country Scores to the right of the Display Country Layers icon in the top-right corner toggles the color scoring of the countries in RAST on and off.

The Resiliency Analysis and Coordination System (TRACS)



Figure 18. RAST—Display Country Layers

RAST also offers Map, Satellite, and Terrain views to give the analyst (and ultimately the decision-maker) a view of the topography of the area for better employment of resources in and out of the country. Figures 19 and 20 show the Satellite and Terrain views, respectively. With these views selected, updates via satellite imagery can show decision-makers, such as CCDRs and civilian organizations, the potential obstacles of transporting supplies and resources in and out of the country that may lie in front of the decision makers.



Figure 19. RAST—Satellite View

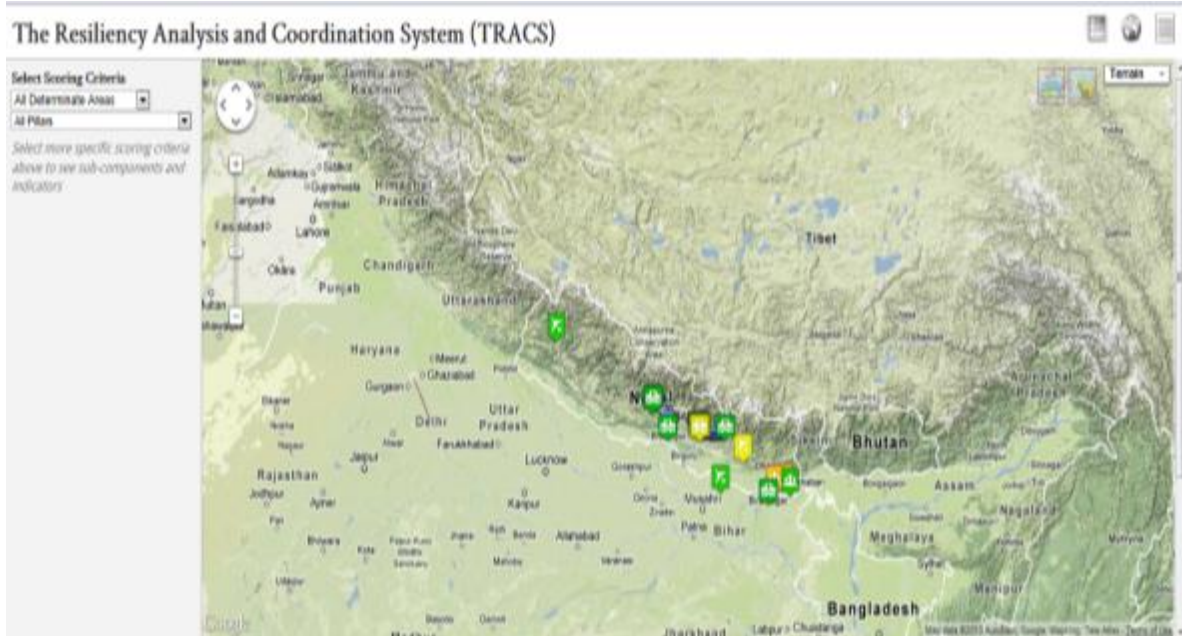


Figure 20. RAST—Terrain View

2. Pre-Crisis View—System View

RAST displays the infrastructure of Nepal in different system categories. To view these pre-crisis system categories, the analyst must switch from the Globe View in the top right-hand corner to the System View. Once System View is selected, the analyst must select the Systems View (Baseline) to see the breakdown of Nepal’s infrastructure by Governing, Public Health, Financial, Education, Utilities, Business/Industry, and Environment systems. For this scenario, we will focus on Public Health during a crisis. To see the Public Health breakdown, the analyst must select “Public Health,” as shown in Figure 21.

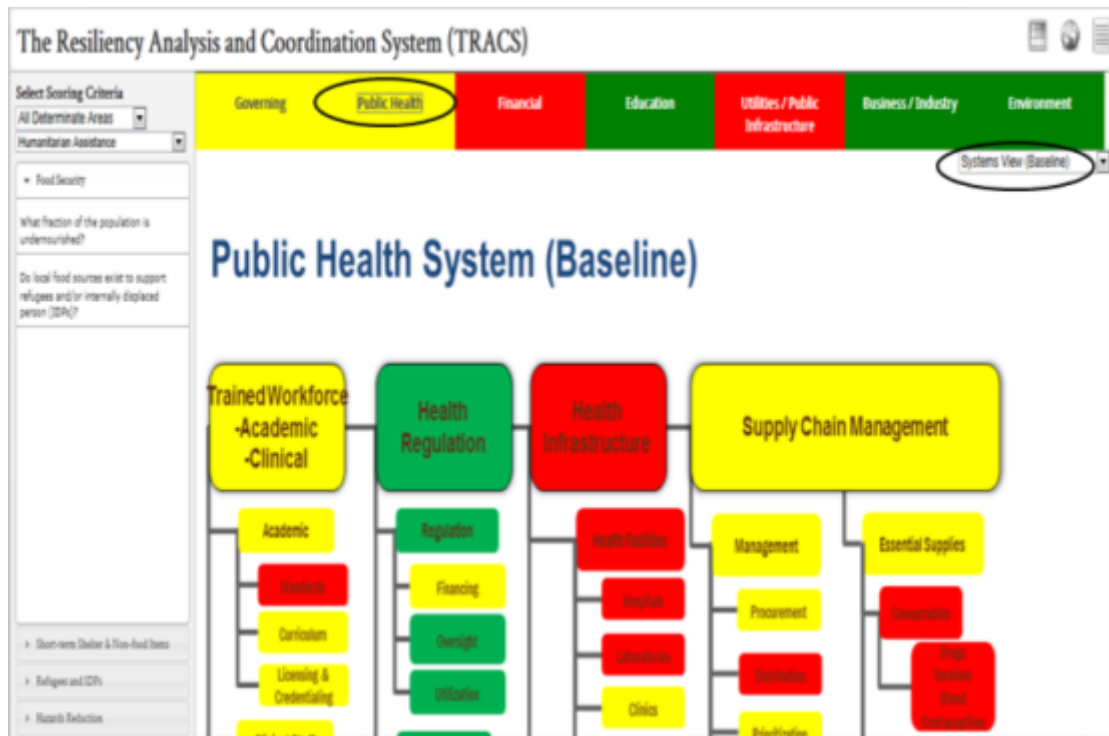


Figure 21. Pre-Crisis—Nepal Public Health System

From Figure 21, the analyst can see that the current pre-crisis Public Health System is already experiencing trouble in its Health Infrastructure and could use minor assistance in Trained Workforce and Supply Chain Management. Now that the analyst can see what the current infrastructure looks like for Nepal, specifically its Public Health System, we will switch to the List View to see a few more key features of RAST.

3. Pre-Crisis View—List View

With the Global View and System View of RAST understood, we now move into the Data Set view to show how updates and information are fed into RAST by selecting the List View. After selecting List View, the program will display a series of registered data sets in descending order from the most recently added set to the oldest. These data sets will update RAST with new data as it comes available and will populate resources and make obtainable important information that decision-makers will rely on heavily. The validity of this information can also be affected by the analyst updating the data set. For example, with this scenario we are looking at a pre-crisis view of Nepal. We are focusing on the Public Health System of Nepal. Once Public Health System is selected, a

series of pillars are displayed that pertain to public health with underlying sub-pillars that decision-makers may address. With Public Health System selected and Potable Water being the selected sub-pillar, the analyst can review data such as Percentage of population with access to potable water. Figure 22 displays a snapshot of the data setup to this point.

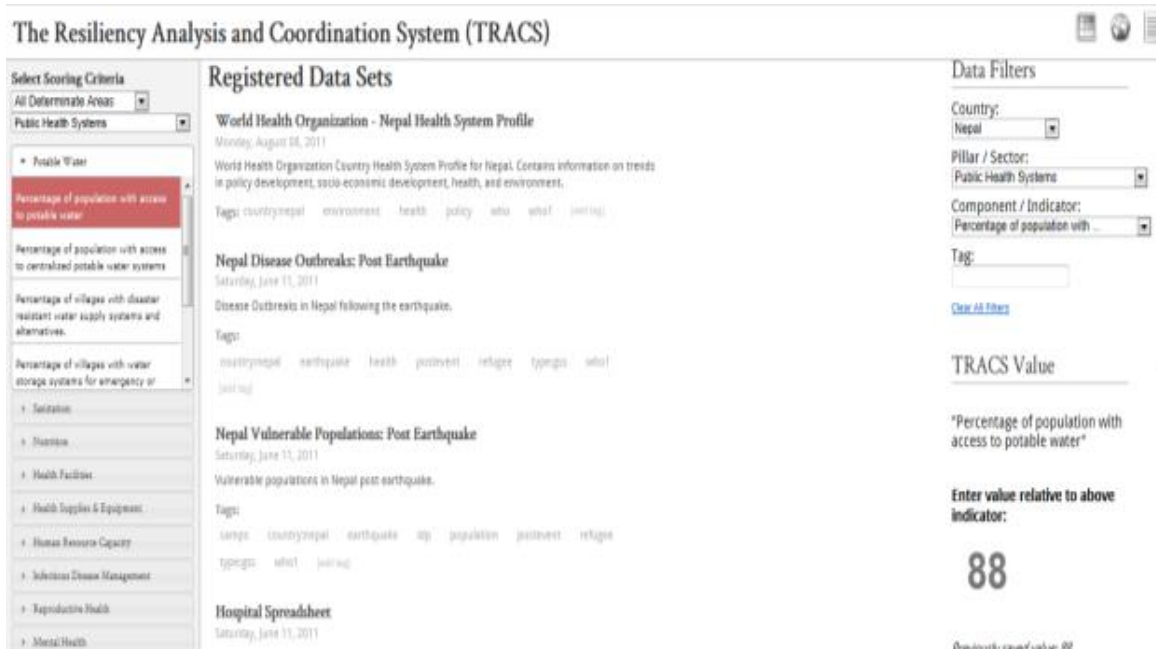


Figure 22. RAST—Registered Data Sets

The value of Percentage of population with access to potable water is currently set at 88%, but this value can be changed by the analyst. If the value were to change because of crisis to a below optimal standard, then the overall rating and color scheme of the country would change from its original light green. For example, if the percentage changed from 88% to 10%, the color scheme of Nepal in Global View would not change from its original light green color while viewing All Pillars because RAST is averaging all the pillars simultaneously. However, when the analyst and the decision-makers begin narrowing down into the details, the color scheme of Nepal will change. Since the Percentage of population with access to potable water was selected and changed, with the “Public Health System” pillar selected, the country of Nepal’s color scheme will change to a light red to show that there is a substantial issue with potable water being accessed by the populace. Figure 23 depicts the results of this change on Nepal.

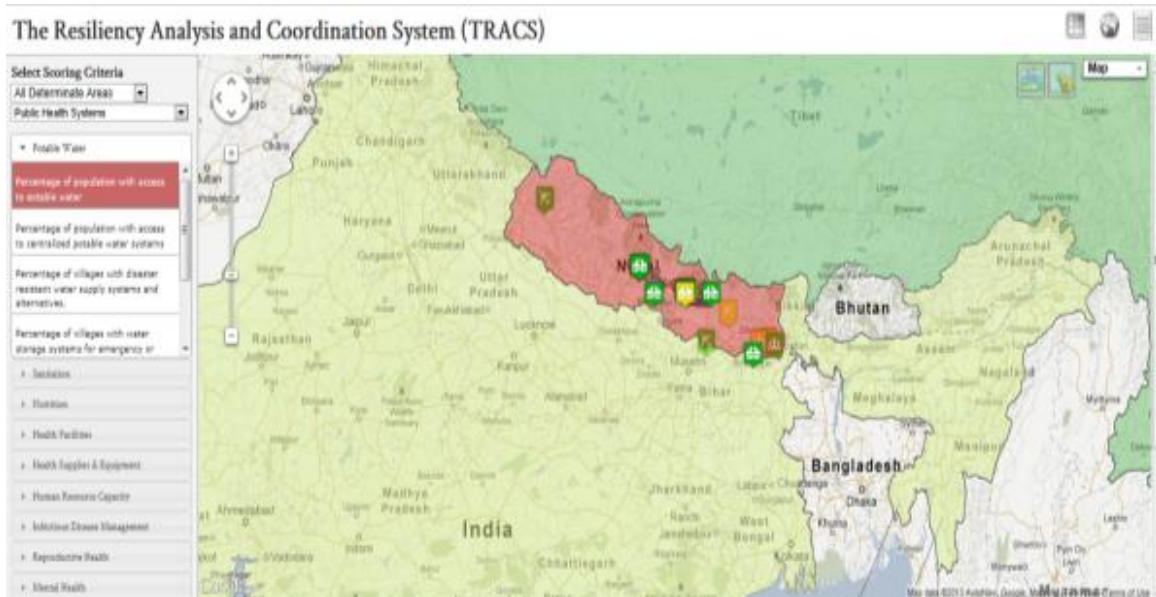


Figure 23. RAST—Potable Water Change

Other capabilities of RAST while in the List View are the ability to register new data sets that are applicable to specific pillars, add notes to the reasons why the analyst changed their numeric scoring of a pillar, and add already registered data sets to pillars by using drag-and-drop functions. With a basic understanding of RAST, we proceed with our scenario of Nepal and the use of RAST during the crisis with snapshots of relief efforts that occur.

B. IMPLEMENTATION OF RAST IN NEPAL—POST-CRISIS

1. Initial Scenario Constraints

The scenario we chose to perform for this project is an outbreak of multiple symptoms of cholera, malaria, and dysentery in the country of Nepal. These outbreaks can be fairly common when water sources have become contaminated. Although earthquakes and tsunamis seemingly occur more frequently and would seem a more optimal choice due to the extensive historical data available, we were constrained in the scenarios we could run with RAST due to its current setup because RAST is in its development phase. Once RAST is fully operational, additional hypothetical scenarios can be run to better train military and civilian responders.

2. Scenario Start

At 0807 Zulu time (0007 PST) on March 8, 2013, an earthquake struck the city of Kathmandu that measured an 8.1 on the Richter scale, causing power outages in the country, minimum structural damage in the city limits, slight road damage, and major freshwater piping damage throughout the country. Many hospitals, government offices, and communication facilities have switched to back-up generators for the time being. The government and economy appear to be in a stable state and force protection and security assistance are not being requested from Nepal.

Once believing it could handle the clean-up efforts within its borders, at 1634 Zulu time (0834 PST) on March 10, Nepal requested assistance in its recovery from the outside world. Nepal has stated to the World Health Organization (WHO) that various cities have reported outbreaks of cholera, malaria, and dysentery post-earthquake, and Nepal is certain it is due to its inability to supply freshwater and provide freshwater services to the surrounding areas. It is also assumed that the multiple outbreaks can be attributed to poor potable water treatment facilities and practices in Nepal. Nepal is requesting assistance from the outside world to battle this outbreak and bring its potable water standards back to optimal standards. Pacific Command (PACOM) has been informed of this outbreak and is aware of the assistance Nepal is requesting. Outside NGOs, including the Red Cross, have also been informed and are making preparations to respond.

a. What Should First Responders Do?

First responders arriving to the post-earthquake scene could get an idea of the country's relief efforts thus far by taking a look at RAST in the "Global View" to see the areas that are primarily impacted by the outbreaks and what relief efforts the country has provided thus far. Figure 24 shows the overall color scheme of Nepal, various points in the country that have been affected by the outbreaks, and relief efforts that are being undertaken.

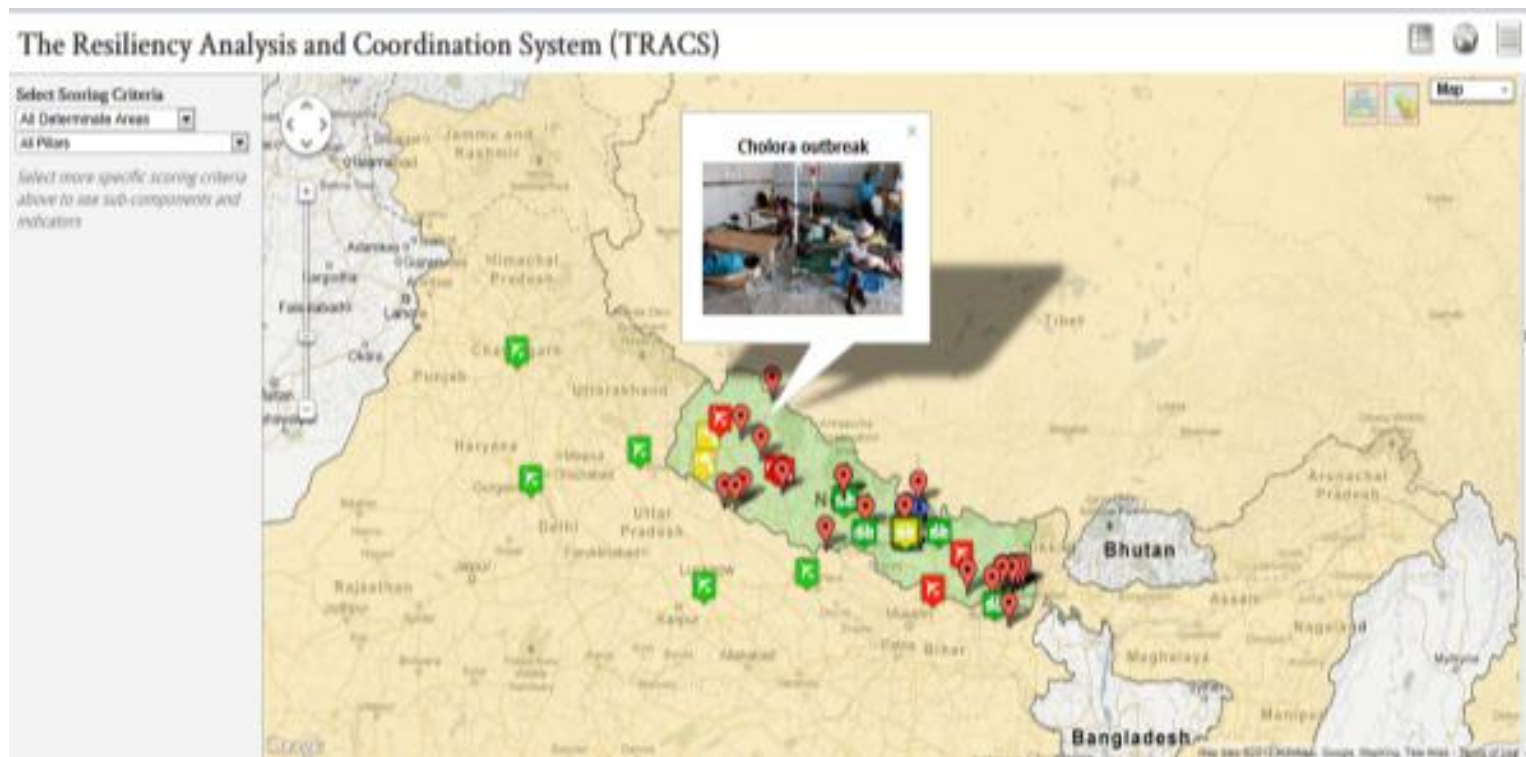


Figure 24. RAST—Post-Earthquake in Global View

One thing to note in Figure 24 is that RAST is currently viewing “All Pillars” and is, therefore, grading all its subsequent categories simultaneously. This is the reasoning for the light-green grading.

For the first responders to see the effect of the individual pillars on the country, the responder would click on the pull-down menu in the top-left corner and select the “Scoring Criteria” and pillar that the responder is interested in. Also, in Figure 24 there are individual “pins” that are displayed showing areas impacted by the outbreak that first responders would be interested in. (The pins are created by the country’s own inputs into RAST under the List View.) First responders can scroll over each of the pins and see the different outbreaks, camps that have been created for relief by the country, and local airports and hospitals in the areas.

Since Nepal specifically asked for relief efforts in the areas lacking potable water, first responders should scroll to the Scoring Criteria and select the Public Health Systems pillar to display the sub-pillars of interest. In this case, we are interested in potable water. After selecting potable water, the country’s grading scheme turns to a dark green. This would seem confusing to many responders because the country is suffering from significant outbreaks and has no way to supply fresh water to its population. The reason for this dark-green grading is because there has been no input into RAST from Nepal on the country’s current potable water status. This would signal to first responders that field agents and analysts are needed to visually grade the country’s ability to create and transport potable water. It would also signal to responders that field medical teams should be ready to respond if the outbreaks worsen.

First responders should next take a look at RAST through the System View link. Responders can now see that the hierarchy for the Public Health System, as displayed in Figure 25, has become more degraded than it was in Figure 18.

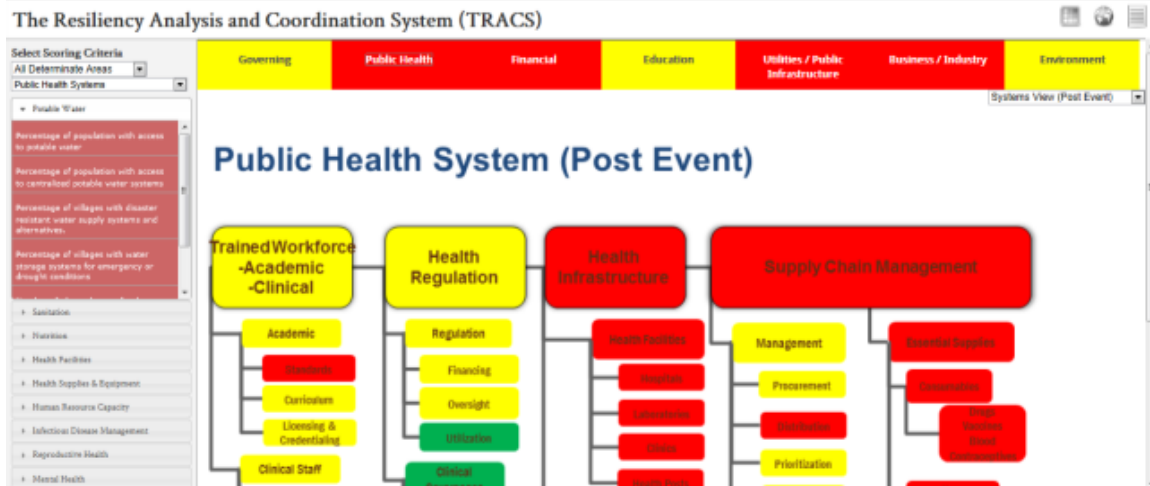


Figure 25. Public Health System—Post Event

Although the “Public Health System” has become more degraded post-earthquake, first responders only can get an idea of what the current infrastructure is like. It will take field agents to evaluate the situation and update RAST to ensure its accuracy. While RAST is a useful situational awareness tool for first responders, it should be pointed out that sometimes RAST may not be updated as efficiently as it should be, so first responders should be ready and flexible in their efforts. From the information shown in Figure 25, first responders can know with certainty that post-earthquake Nepal has had significant outbreaks of disease and the location of these outbreaks. They know the nearest medical treatment camps, hospitals and airports for medical relief and logistics of supplies, and they know that the cause of the problem is due to poor potable water supply to the cities in Nepal. The areas of concern for first responders are how extensive the damage is to the potable water pipes, and what will be needed to bring the country back to optimal standards.

b. The Use of RAST in the Field

With the information that first responders have, they can now deploy field agents to Nepal to collect better information about the current potable water situation. In the future, RAST will be capable of being accessed from any portable electronic device (smart phones, iPads, etc.) and being updated consistently by field agents.

For this scenario, we will assume RAST has this capability. Even if the country's communication towers make the Internet inaccessible, Wi-Fi hotspots and cloud computing make updating RAST in the field easy. Communications are still available and communications outside of the country are still possible. Field agents that are sent into Nepal will update RAST as data become available regarding the potable water situation by accessing the List View, selecting the Public Health System pillar, and selecting the Potable Water sub-pillar. Here the field agent(s) can provide updated information about the accessibility to potable water by the country and its infrastructure post-earthquake. In the scenario, the field agents have realized that the available potable water percentage has changed from 88% to 10%. After field agents have updated this information in RAST, outside military and civilian response organizations can now see that the potable water issue in Nepal has changed to a light-red grading scheme. Field agents also have the capability to provide notes on the reasoning for their grading and significant impacts they saw in the field. With this information, decision-makers and first responders can now move in and provide relief efforts.

3. Relief Efforts and RAST

First responders and decision-makers now have a clearer picture of the situation in Nepal. With an understanding of areas that are impacted by disease and cities that are in need of clean potable water and infrastructure repair of potable water systems, civilian and military organizations can now move in.

As with any HA/DR relief effort, a command-and-control structure must be established first. (We want to note that identification of the command-and-control structure is not a RAST capability, but is a recommendation we have for RAST in its development. We will treat it as an already-in-place capability for this scenario.) Many of the lessons learned from previous disasters all claim that there was no clear command structure. In this scenario, PACOM will have overall command of and responsibility for the relief efforts in Nepal. Civilian organizations will consult with their military counterparts before conducting relief efforts. EOC tents will be established in the field that civilian organizations will have access to so they can provide relief efforts alongside

military organizations. This will ensure that civilian and military organizations both understand the efforts taking place and that resources are used efficiently. Field agents will update EOC tents and RAST as relief efforts occur, and civilian and military organizations will communicate with field agents to ensure the accuracy of their findings.

Once these data are input into RAST and deemed accurate, EOC tents will communicate to their respective organizations regarding the progress of the relief efforts, and a designated field officer/representative will brief PACOM as milestones are met. When all relief efforts have brought Nepal back to an optimal potable water standard and the infrastructure is rebuilt, field agents will update RAST and the EOC. The EOC will update their organizations and the designated officer/field representative will update PACOM. PACOM will give the approval for civilian and military organizations to begin extraction of Nepal, leaving a small footprint of the organizations' presence.

In Chapter VI, we provide recommendations for the improvement of RAST and capabilities we feel would make RAST a more optimal tool in HA/DR operations.

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VI. RECOMMENDATIONS FOR RAST

A. IMPROVEMENT OPPORTUNITIES FOR RAST

RAST is still in its development phase. However, the right design implementations will make it a better tool. We offer the following recommendations for the continued improvement of RAST.

1. Social Media

One recommendation is adding social media channels as input sources for RAST. With large-scale use of social media outlets such as YouTube, Facebook, and Twitter, videos and pictures that are uploaded to these social media outlets could feed into RAST, giving first responders a better idea of the situation in Nepal (and any country post-crisis) before field agents are sent in to determine the accuracy of inputs into RAST.

2. Grading Scheme

We also recommend a different grading scheme than the 0–100 scale used to determine a country's current structure. We feel that this scale is more difficult for field agents and analysts to determine what percentage best correlates to the country's current status. We feel that an alphabetized grading scheme would prove to be a better tool for field agents when trying to quantify their findings. For example, if the potable water infrastructure was significantly degraded and deemed unacceptable, how would a field agent know it should be a 10% or 20% grading? We feel that by changing the grading scheme to an alphabetized criterion (A–F), field agents could better quantify their findings and track the progress of relief efforts. For example, if the field agent arrived in Nepal, found the potable water infrastructure to be significantly degraded, and deemed it unacceptable, the infrastructure would be graded with an F. This grading would then change the color scheme of the country to a dark red. The same could be applied for the other color schemes and their respective colors (A = dark green, B = light green, C = yellow, D = light red, F = dark red).

3. Instant Messaging/Chat Groups

Another recommendation we have for RAST while it is still in the development phase is an instant messaging (IM) capability. Although talk and text forms of communication are available, we feel that if a field agent or a representative working in the EOC tent is occupied with a situation, then IM would provide a quick communication outlet that field agents or the EOC tent could respond to when they are free to answer. For instance, if a field agent is speaking to engineers installing new piping in a potable water facility or training is occurring with potable water facility personnel, EOC tent representatives can IM the field agent what they need to communicate and the field agent can respond when they have time.

We also recommend a chat board as an added feature that will allow tailoring of chat groups so that field analysts in a specific military or civilian organization can communicate to their requisite organizations without relying on voice communications. Having a chat feature will make relief efforts that are being led by specific group, military or civilian, keep all customers in the loop. Specific information can be made available in group forums or whisper boxes can be made for more private conversations.

4. Topography Snapshots

We recommend that a function be added to RAST in the “Global View” to show before-and-after snapshot imagery of the topography to give decision-makers an idea of how the land has changed from pre-crisis to post-crisis. Since changes in terrain can occur from major earthquakes and tsunamis, this would be a beneficial addition to RAST. It would also benefit first responders prior to their arrival to see what roads and airports are available for coordination of supplies into the affected areas. In our scenario, a before-and-after snapshot of the topography would help first responders see the impact of earthquakes on the surrounding cities and the water treatment facilities that were affected.

5. Command Hierarchy/Command-and-Control Structure

We also recommend a screen view of RAST that shows the current command hierarchy and the command-and-control structure. This will be beneficial because of the

time and resource savings it provides to the overall relief effort. When civilian and/or military organizations respond to a crisis, they will know where to report and whom they should consult before engaging in relief efforts. This will cut down on resources being used inefficiently and decrease the response time for providing relief to those affected, which will, in turn, save lives.

In Chapter VII, we provide our conclusions and recommendations for follow-on research to better assist RAST in its development.

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VII. CONCLUSION

A. RAST APPLICABILITY IN THE FIELD

Although RAST is still in the development phase, our review shows that it has potential to be a valuable asset for HA/DR responders. Its applicability as a situational awareness tool prior to involvement by civilian and military organizations could improve resource allocation coordination, which has been a hindrance in the past. It could also help paint an overall picture to decision-makers so that optimal assessments can be made of the requirements needed to bring the country in need back to optimal standards. RAST could provide benefit by showing the country's progression through the phases of relief as they occur and ensure that all players are always on the same page. We have found in our scenario in Nepal that RAST can be a beneficial tool for both primary and secondary customers, but there is still more work that needs to be done. With the recommendations of improvement we noted in Chapter V and the follow-on research we present in the next section, we feel that RAST is on its way to being a tool that can reduce response rates, optimize resources, and, ultimately, save lives.

B. FOLLOW-ON RESEARCH

Table 4 contains a list of follow-on research items we feel would better support RAST in its development. Since we were constrained by the current setup of RAST, we feel that as RAST becomes more developed, further research can be conducted in these areas to better implement its uses. We do not feel that future researchers should limit themselves to only these opportunities, but should consider them for future involvement in ongoing research.

Table 4. Follow-On Research Recommendations

Conduct an updated scenario of RAST in the PACOM AOR with the upcoming design improvements from the PACOM point of view.
Conduct a study of the integration of RAST with military and civilian personnel using role-play environments to include before training with RAST, after training with RAST, and inter-organizational responses.
Conduct an assessment of RAST from the point of view of the secondary customer and of the RAST operator before and after training.
Conduct a study of the integration of military symbology with RAST and determine its effectiveness in usability.
Conduct an assessment of types of data that should be shared between military and civilian organizations in RAST and if possible policy roadblocks could exist.
Conduct a survey to provide suggestions on the structure of RAST and what would make it easier to understand and effectively use for both the primary and secondary customer.

LIST OF REFERENCES

- Apte, A. (2009). Humanitarian logistics: A new field of research and action. *Foundations and Trends in Technology, Information and Operations Management*, 3(1), 1–100.
- Apte, A., & Yoder, E. C. (2011). *When disaster strikes, is logistics and contracting support ready?* (NPS-LM-11–185). Retrieved from Naval Postgraduate School, Acquisition Research Program website:
<http://www.acquisitionresearch.net/publications/detail/811/>
- Center for Excellence in Disaster Management and Humanitarian Assistance. (2011, December 8). *The resiliency analysis and coordination system (TRACS): Advancing HA/DR decision-making capability*. [Presentation Slides]. PowerPoint briefing at Tripler AMC, HI: COE-DMHA.
- Department of Defense (DoD). (2009, September 16). *Stability Operations* (DoD Instruction 3000.05). Retrieved from
<http://www.dtic.mil/whs/directives/corres/pdf/300005p.pdf>
- Department of Defense (DoD). (2011, July 13). *Support to foreign disaster relief*. Retrieved from <http://www.fas.org/irp/doddir/dod/disaster.pdf>
- Department of Defense (DoD). (2012a). *Defense support of civil authorities (DSCA)* (DoD Directive 3025.18). Retrieved from
<http://www.dtic.mil/whs/directives/corres/dir.html>
- Department of Defense (DoD). (2012b). *Foreign disaster relief (FDR)* (DoD Directive 5100.46). Retrieved from <http://www.dtic.mil/whs/directives/corres/dir.html>
- Emergency Events Database (EM-DAT). (2012). *Natural disasters reported from 1975 to 2011*. Retrieved from <http://www.emdat.be/natural-disasters-trends>
- Federal Emergency Management Agency (FEMA). (1990, April 4). *Definitions of terms*. Washington, DC: FEMA.
- Joint Chiefs of Staff (JCS). (2009, March 17). *Foreign humanitarian assistance* (Joint Publication 329). Retrieved from
http://www.dtic.mil/doctrine/new_pubs/jointpub_operations.htm

- Kaul, D. C. (n.d.). *Consequences assessment tool set (CATS)*. Retrieved from <http://proceedings.esri.com/library/userconf/proc00/professional/papers/pap722/p722.htm>
- Kehlet, R. (n.d.). *The use of the consequences assessment tool set*. Retrieved from <http://proceedings.esri.com/library/userconf/proc97/proc97/to400/pap383/p383.htm>
- Koch, M. T. (2011, April). *HA/DR lessons learned (OMB No. 0704–0188)*. Newport, RI: Naval War College. Retrieved from <http://www.dtic.mil/dtic/tr/fulltext/u2/a546338.pdf>
- Kovacs, G., & Spens, K. (2007). Humanitarian logistics in disaster relief operations. *International Journal of Physical Distribution & Logistics Management*, 37(2), 99–114. doi: 10.1108/09600030710734820
- Library of Congress, Congressional Research Service. (2008) *The use of federal troops for disaster assistance: Legal issues* by Elsea, J. K., & Mason, R. C. (CRS Report RS22266). Washington DC: Office of Congressional Information and Publishing. Retrieved from <https://opencrs.com/>
- McGrady, E., Kingsley, M., & Stewart, J. (2010, November). *Climate change: Potential effects on demands for U.S. military humanitarian assistance and disaster response (13873/2REV)*. Alexandria, VA. Retrieved from <http://www.cna.org/sites/default/files/research/Climate%20Change%20and%20Military%2013873.pdf>
- Meyer, R. (2011). *Simple messaging and collaboration system for heterogeneous organizations operating in disaster environments* (Unpublished master's thesis). Naval Postgraduate School, Monterey, CA.
- Office of Naval Research (ONR). (2012, February 9). *Aid missions get cutting-edge assistance from ONR*. [Press Release]. Arlington, VA: Katherine Crawford. Retrieved from <http://www.onr.navy.mil/Media-Center/Press-Releases/2012/Humanitarian-AID-Disaster-Relief-ONR.aspx>
- Robert T. Stafford Disaster Relief and Emergency Assistance Act (RSDREA), 42 U.S.C. §§ 5121–5207 (2007). Retrieved from <http://www.fema.gov/robert-t-stafford-disaster-relief-and-emergency-assistance-act-public-law-93–288-amended>
- Samuels, W. B. (2009). *Consequences assessment tool set (CATS)*. Retrieved from <https://www.saic.com/products/security/cats/CATS-FS.pdf>
- Stevens, T. (2011). *CATS-consequences assessment tool set*. Retrieved from <http://www.ebmtoolsdatabase.org/tool/cats-consequences-assessment-tool-set>

- Swiatek, J. A., & Kaul, D. C. (Eds.). (1999). *Crisis prediction disaster management*. Retrieved from <http://www.google.com/url?sa=t&rct=j&q=consequences%20assessment%20tool%20set%20swiatek%20and%20kaul&source=web&cd=1&sqi=2&ved=0CC8QFjAA&url=http%3A%2F%2Fciteseerx.ist.psu.edu%2Fviewdoc%2Fdownload%3Fdoi%3D10.1.1.197.42%26rep%3Drep1%26type%3Dpdf&ei=xMk6UZfHM6HL2QWWp4CYAg&usg=AFQjCNEeFFF7frXaKxSh20sGUorR6JEUPA>
- Teasley, S. L., Covi, M. S., & Olson, J. S. (2000). How does radical collocation help a team succeed? In *CSCW 2000: Computer supported cooperative work*. New York, NY: Association for Computing Machinery.
- United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). (2009). *Policy brief on ICT applications in the knowledge economy*. New York, NY: United Nations.
- United Nations Foundation (UNF). (2011). *Disaster relief 2.0: The future of information sharing in humanitarian emergencies*. Retrieved from <http://www.unfoundation.org/assets/pdf/disaster-relief-20-report.pdf>
- Will, A. J., Chinowsky, P., & Senesi, C. (2010, November). *Disasters: Impact of country level variables on recovery progression (EPOS Working Paper)*. Retrieved from Engineering Project Organizations Conference website: http://academiceventplanner.com/EPOC2010/Papers/EPOC_2010_Javernick-WillChinowskySenesi.pdf

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